

ARCTIC

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Cover Picture. Women at Pangnirtung, Baffin Island.

(Photo: National Film Board, Canada)

Frontispiece. *USS Northwind*.

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Photos: United States Coast Guard.

Top: United States Coast Guard icebreaker *Northwind* preparing to leave New York harbour on a 1946 expedition which reached as far west as Winter Harbour, Melville Island, Canada. *Bottom:* *Northwind* at left, with U.S.S. *Whitewood* refuel while on the 1946 expedition to northern Greenland and Canada.

A MESSAGE FROM THE ARCTIC INSTITUTE OF NORTH AMERICA

IN THE spring of 1848 the first expeditions sailed in search of the lost Franklin expedition. Unfortunately Franklin and most of his men were already dead. Although this was unknown to the early relief expeditions, it must have seemed increasingly probable to the crews of the forty ships which followed during the next eleven years. Increasingly they felt free to turn their attention to the discovery of those unknown islands among which the expedition had so mysteriously disappeared. Before clear evidence of the tragedy was found, the northwest passage had been negotiated and most of the Canadian Arctic archipelago had been outlined.

Today it is appropriate to look back a century and realize that these same inhospitable regions are the scene of activity such as they have not known in the intervening years. Spurred by no tragedy, assisted by aids unknown even a generation ago, the exploration, mapping and scientific study of the North American Arctic is now being pursued on a scale never before possible.

What an unique opportunity it is! The world revolves about the polar regions. The magnetic poles, the aurora, the effects of continuous summer sunlight, the winter's cold are strange physical attributes that make the background to this exploration of the world's last undiscovered frontiers as fascinating today as it has ever been.

Discovery was not the only achievement of the Franklin search, for it elicited world wide sympathy and support from many nations. Bellot Strait at the extreme northern boundary of the mainland was named for a French volunteer. The Danish and Russian governments assisted search parties. Henry Grinnell of Philadelphia equipped two expeditions which were commanded by United States Navy officers. Although De Haven and Kane did not find Franklin, their discoveries first aroused that American interest in Ellesmere Island and northern Greenland that led to later expeditions in search of the pole.

All these efforts, inspired by noble motives, were happily marked by an absence of quarrelling and a generous recognition of the achievements of others. As an international, scientific society the Arctic Institute of North America can wish for no better guide to its conduct than these examples of international goodwill a hundred years ago. The small group of men who four years ago formed this private society and maintained control of it until it was established upon a secure foundation, are now anxious to see a larger number of those interested in the North American Arctic take an active part in the Institute's affairs. As a means of bringing this about they invite all persons interested to join the Institute; they have limited the number of times any Governor may be re-elected and they now launch this journal as a means of communicating information about the Arctic and the activities of the Institute to all its members and to the wider public that may be interested in the ends of the earth.

J. TUZO WILSON,
Chairman, Board of Governors, 1947.

INTERNATIONAL COOPERATION IN ARCTIC RESEARCH¹

By A. L. WASHBURN

PROBABLY in few regions of the world are the opportunities for international scientific cooperation greater than in the Far North. From west to east, the United States (Alaska), Canada, Newfoundland (Labrador), Iceland, Denmark (Greenland), Norway, Sweden, Finland, and the Soviet Union are all vitally concerned in Arctic and Subarctic problems. And many other countries have contributed significant chapters in the ever-expanding book of knowledge entitled "The North".

Scientific problems are similar regardless of international boundaries, and the number of problems in the Arctic and Subarctic that can be best solved by international cooperation is legion. In fact many of them can be solved only by international cooperation. The desirability of such cooperation and of a circumpolar background is stressed by Professor V. C. Wynne-Edwards²: "Parallel investigations along many lines are being made in Alaska, Scandinavia and the U.S.S.R. The importance, from the purely scientific as well as the practical and economic standpoint, of acquainting the investigators of this country at first hand with similar problems and conditions in other northern lands cannot be too strongly stressed. Understanding and insight are born of experience; and the need for a circumpolar background must be evident to many besides myself."

Considerable cooperative work has been done in the fields of meteorology and climatology, especially through the rapid exchange of observations for forecasting purposes. Although most of this cooperative effort has been confined to non-Arctic investigations, the need for focusing more attention to Arctic weather is becoming apparent. As Dr. F. W. Reichelderfer (*Ibid*, p. 11) points out, more information is needed on "Connections and interactions between the semi-permanent centers such as: The Aleutian low, Icelandic low, Siberian high, Greenland high or low, North American high, Azores-Bermuda high, Polar high, Asiatic monsoons, etc." The very terms used by Dr. Reichelderfer point to the international character of the problem. Its importance is seen in the fact that much of the weather affecting more southerly regions originates in the Far North. The greatest ice cap in the Northern Hemisphere lies on Greenland and although its exact effect on weather elsewhere is not well-known it is certainly international in character.

Like weather, oceanography offers problems to all the countries fronting the Arctic Sea. Greenland, Iceland, Norway, Finland, and the Soviet Union

¹Summarized from a statement in *Biologia*, Vol. 1, No. 6, Autumn 1947, pp. 23-4, by permission.

²The Arctic Institute of North America (1946): *A program of desirable scientific investigations in Arctic North America*, p. 30-31.

are all influenced by the Gulf Stream, to a greater or less degree, to cite just one of the common denominators which requires cooperative effort for its thorough study. The course of the Gulf Stream is not a rigidly fixed thing but varies slightly. It is most important to keep a close watch of these variations, for the Gulf Stream can affect the everyday life of man in the North in a number of ways; for instance, by influencing climate, controlling the sites of commercial fisheries, and in facilitating ice-free navigation in high latitudes as at Murmansk. In many places oceanographical investigations, especially those dealing with currents, should be carried out by simultaneous observations by countries fronting a common body of water. Less than sixty miles separate the shores of Siberia from Alaska. Here in Bering Strait alone there exist an abundance of oceanographical problems such as tides, currents, sea ice, and others whose cooperative study would materially benefit science as a whole as well as the two countries primarily involved.

Some phases of geology in the Arctic and Subarctic lend themselves extremely well to an international approach. The Pleistocene ice sheets of the Northern Hemisphere originated in the North, but it is not certain that they originated simultaneously in Europe, Asia, and North America, or that they underwent the same stages of growth and decay. The history of the Ice Age in Canada's Arctic Islands, in Greenland, Spitsbergen, Novaya Zemlya, Severnaya Zemlya, and other island groups in the Arctic Sea is even more of a mystery. Not only geology, but also climatology, botany, zoology, and numerous other subjects that know no national boundaries would be advanced by detailed information of what took place in the Arctic and Subarctic during the Ice Age.

Problems of natural history offer a very promising opportunity for international cooperation in Arctic research. Arctic fishes are an example. According to Dr. Leonard P. Schultz (*Ibid*, p. 45) "Adequate collections of fishes, including freshwater fishes, marine-shore, pelagic, deep-sea, and bottom fishes, have never been made, except possibly around Iceland and northern Europe. This leaves all of the polar seas, northern Asia, and northern North America and Greenland, regions yet to be explored ichthyologically."

Newfoundland seals move to West Greenland and to the Canadian Eastern Arctic in the spring. Seals breeding in the Jan Mayen area may go to West Greenland in the summer. Thus some seals, like some migratory birds, are international travelers. Many seals breed off Newfoundland and sealing here is commercially profitable and a national industry. On the other hand, Greenlanders and Canadian Eskimos depend to a large extent on seals for their daily food and clothing, and some of these seals come from New-

foundland. Thus these international travelers become an international conservation problem.

That there are a number of illustrations of international action on conservation problems is seen in treaties related to fisheries, seals, whales, and migratory birds. An example is the agreement between the Soviet Union, United States, Canada and Japan which has prevented the extermination of the fur seal. Since cooperation can be obtained on problems where national economic interests are an important factor, it should be still easier for scientists of different countries to work together on problems, such as the glacial and post-glacial history of faunas and floras throughout the North, where national economic and political interests are minimal.

International cooperation is absolutely essential to the solution of problems dealing with the broad history of faunas and floras. The freshwater fauna of the Mackenzie Valley, which is a mixture involving Siberian elements, is an example. Dr. Austin H. Clark (*Ibid*, p. 34) points out that "... arctic North America and arctic Asia are but different sections of the same great faunal and floral province with many animals and plants in common. . . ." The number of problems demanding eventual cooperation in this field alone are therefore countless. Dr. Raymond M. Gilmore (*Ibid*, p. 35) writes, "Much of our American arctic mammalian fauna needs to be taxonomically revised, especially with Siberian specimens for comparison." The former existence of a land bridge across the present site of Bering Strait, plays a large role here. Dr. Gilmore continues "... the whole Beringian region is a faunistic endemic area, and moreover, it is the bridge-area between the Western and Eastern Hemispheres; all the great and near-great of the intercontinental emigrators and immigrators, and the small-fry, slept there."

International cooperation is also essential in solving the problems surrounding primitive man who spread from Siberia, across Alaska to northern Canada and Greenland. More archeological investigations and linguistic studies must be undertaken in all these places. For instance, following Dr. Henry B. Collins, Jr., (*Ibid*, p. 50, 52) "It seems safe to say that the important problems of the physical and cultural relationships of the Aleuts to neighboring peoples in Alaska and Siberia cannot be solved on the basis of the materials now available." He believes, "Systematic excavation in northeast Siberia is the greatest desideratum in Eskimo archaeology. . . ."

Not only the past history of man in the Arctic requires the cooperation of all northern countries for its accurate delineation, but also the present day to day activities of northern dwellers requires this working together. The pooling of experience gained under similar environmental conditions is of mutual benefit. Take for instance northern agriculture which requires

hardy seeds. Different varieties are known from investigations in a number of northern countries, and the international exchange of agricultural information and seeds cannot help but be beneficial to all parties concerned.

International cooperation is called for in all the above fields of Arctic research. There are many others that could have been added. Although treated as different fields of scientific work, they are really so interdependent that they become merely different phases of one international regional problem—the Arctic. The day to day exchange of published scientific papers among specialists, informal correspondence, joint expeditions, and the close cooperation of scientific societies and research institutes are all ways of facilitating international cooperation in solving the many problems that exist in the Arctic and Subarctic.

ASSOCIATES OF THE ARCTIC INSTITUTE

During the formative years of the Arctic Institute many friends expressed the hope that a means of close association with its objectives might be made possible. In response to this expression the Institute has developed a membership program for Associates of the Arctic Institute. Associates will receive the journal of the Institute biannually and other reports from time to time. The chief qualification for Associate Membership is interest in Arctic work, and the Board of Governors will welcome the widest possible participation. Dues are \$3.00 annually and may be paid in United States or Canadian funds and forwarded to either the New York or Montreal offices of the Institute.

In addition, a class of Fellows of the Arctic Institute is being planned for the near future, the Fellows to be selected from Associates of the Arctic Institute who have done distinguished work in relation to the Polar Regions. It is contemplated that Fellows will take a leading part in Institute affairs and will have the privilege of electing a proportion of the Board of Governors.

THE SEARCH FOR THE NORTH MAGNETIC POLE*

By R. GLENN MADILL

Abstract

The Dominion Observatory has extended its network of magnetic stations in the Arctic to such a stage as to indicate the presence of the north magnetic pole in northern Prince of Wales Island. A brief historical summary of magnetic observations in the north is given followed by an account of the observations made in the summer of 1947. Preliminary values of 1947 results from Arctic magnetic stations and a chart of magnetic meridians constructed from recent declination observations are included.

ON JUNE 2, 1831, Ross fixed the British flag to a spot on Cape Adelaide Regina, Boothia Peninsula, and took possession of the north magnetic pole in the name of Great Britain and King William the Fourth. The spot was a fixed geographical point— $70^{\circ} 5' \text{ N. Lat.}, 96^{\circ} 46' \text{ W. Long.}$ —about which the magnetic pole was perpetually moving. During Ross' observations, extending over a 24-hour period, the pole was moving within an area whose diameter was of the order of 16 miles. Ross arrived at the north magnetic pole on foot having walked from his base at Victory Harbour about 100 miles away.

On May 3, 1904, Amundsen reached a point on Boothia Peninsula apparently about 20 miles from the magnetic pole. He had travelled by sledge from Gjoahavn, King William Island, some 150 miles distant. The pole at that time was computed to be in $70^{\circ} 30' \text{ N. Lat. and } 95^{\circ} 30' \text{ W. Long.}$, about 40 miles northeast of Ross' position. Amundsen established at Gjoahavn a temporary magnetic observatory which operated from November 1903 to May 1905 and furnished control to field observations made during a magnetic survey of parts of King William Island and Boothia Peninsula. This long series of magnetic measurements showed, among other things, that the pole could be displaced in a north-south direction by a range of 150 miles. Had Amundsen been able to surround the magnetic pole area by magnetic stations his site for the mean position of the pole might have been somewhat different.

On August 22, 1947, Serson and Clark landed on the shore of Allen Lake, northeastern Prince of Wales Island, from a Royal Canadian Air Force Canso having flown from Cambridge Bay, Victoria Island, about 325 miles away. The north magnetic pole was probably within 10 miles of them before receding on its uneasy course. The observations at Allen Lake offered evidence that the magnetic pole described some sort of a rough orbit whose radius was of the order of 25 miles on a magnetically quiet and 50 miles on a magnetically disturbed day. The results for this station appear in Table 1.

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TABLE 1

Preliminary values of declination (D) inclination (I) horizontal intensity (H) total intensity (F) and distance (R) from magnetic pole according to local mean time (L.M.T.) at Allen Lake*, northeastern Prince of Wales Island latitude $73^{\circ} 41'N$. longitude $98^{\circ} 26'W$.

DATE	L.M.T.		D		I		H	F	R
1947	h	m	o	'	o	'	gammas	gammas	miles
Aug. 22	16	43	108	58	89	35	422	58177	50
	17	41	130	46	89	21	670	58397	79
	18	09	130	18	89	29	525	58194	62
	19	13	128	35	89	27	563	58241	66
	20	07	127	59	89	24	613	58196	72
	21	07	115	26	89	22	650	58234	77
	22	08	110	25	89	26	574	58245	68
	23	01	111	34	.....	.....	.....	.....	..
23	00	07	112	41	89	33	464	58268	55
	10	03	107	39	89	46	235	58158	28
	11	11	114	00	89	56	59	58272	7
	11	35	133	38	89	45	248	58396	29
	12	03	143	02	89	46	245	58622	29
	12	33	113	41	89	56	69	58236	8
	12	55	131	02	89	40	345	58470	41
	13	21	138	44	89	30	493	58196	60
Means.....			122	24	89	36	412	58287	49

*This name has been used for convenience, but has not been approved by the Geographic Board of Canada.

Nature of the Magnetic Pole

The magnetic pole may be defined as an area rather than a precise point. There the earth's magnetic field is vertical and the dipping needle points towards the centre of the earth. The compass needle is useless since the horizontal force required to hold it in its direction has vanished. The daily fluctuations in position of the pole result from deformations in the magnetic field caused by solar activity operating in the earth's upper atmosphere, while the secular or long term movement has its origin within the earth. The daily fluctuations are limited to a movement about a fixed geographical point which represents the mean position of the pole at the time. It is understood, therefore, when a position for the magnetic pole is indicated it represents the mean centre of an area at a particular epoch.

There exist throughout Canada centres of local attraction where the earth's field is distorted by the presence of magnetic materials in either the rocks or the overburden. The attraction at some of these centres has sufficient strength to create local poles. The effect of local poles is quickly dissipated

in a comparatively short distance from the area. The Canadian Arctic is not free from this condition. There are, for example, known areas of local attraction at Fort Ross, southern Somerset Island, on King William Island and in Coronation Gulf. The effect of restricted areas of local attraction falls off rapidly with altitude above the surface so that aircraft flying at 6,000 feet or higher may employ magnetic charts free of the sinuosities apparent in ground level values. The idea has been advanced that the position of the north magnetic pole, as deduced from magnetic observations made in aircraft at various altitudes, may differ from that calculated from ground observations. Definite conclusions about this must necessarily await the precise determination of the ground position of the magnetic pole.

Earlier Determinations of Magnetic Pole

The position of the north magnetic pole has been the subject of investigation by mathematicians and explorers for almost 250 years. In the past, as today, the position of the magnetic pole was of great scientific interest. A knowledge of the positions where the magnetic axis of the earth intersected the surface was needed to arrive at a complete picture of the earth's magnetic field. Many attempts were made to deduce the position of the north magnetic pole from observations made at various points not in northern regions. Certain assumptions were made which held in the laboratory but were not valid when the earth itself was considered. For example, mathematical formulae were derived on the assumption that curves of equal inclination and horizontal force were concentric circles with the magnetic pole as a common centre. This is not the case since the curves are rather elliptical in shape and not necessarily regularly spaced in relation one to another. Again, it was assumed that the total force of the earth's magnetic field was a maximum at the magnetic pole. This does not agree with measurements made on the earth's surface, as the maximum total force in Canada is to be found in an area to the west of Churchill about 1,000 miles south of the magnetic pole.

If uniformity in design, such as a system of uniformly spaced concentric circles, existed and if the compass needle pointed directly at the pole instead of generally along a curved magnetic meridian, then it would be possible to deduce a geographical position of the pole from values of declination, inclination and horizontal force at any single station. This method was commonly used in the distant past with the result that each station gave a different position of the magnetic pole. The only uniformity in the results was an indication that the north magnetic pole was somewhere north of the Arctic Circle between Greenland and Alaska.

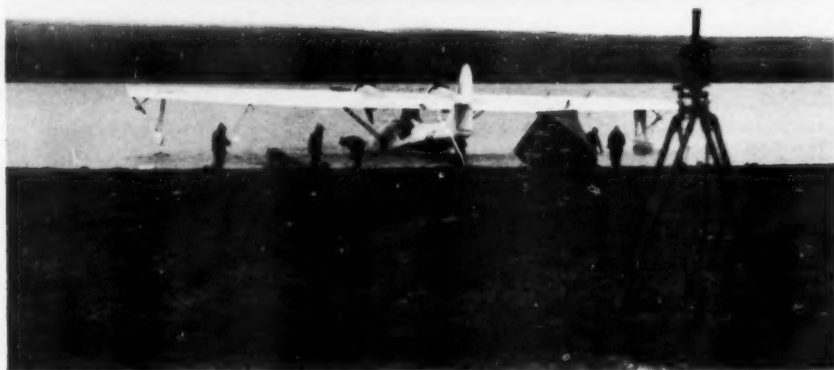
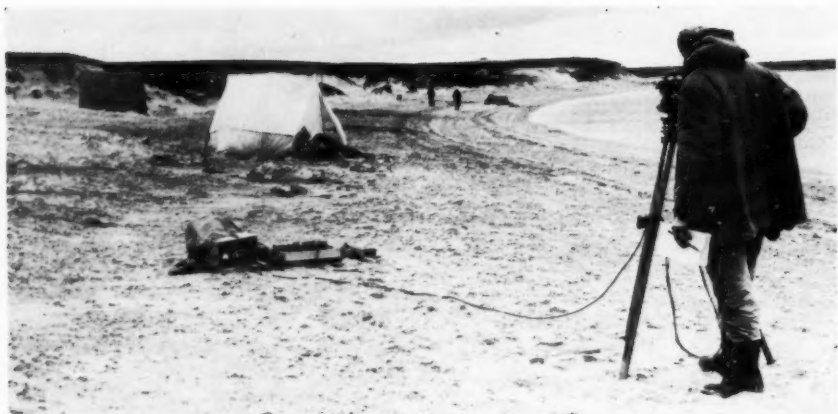
The first magnetic observations made in Arctic regions which assigned a definite restricted area for the pole were those made by Sabine, Parry and Franklin between the years 1818 and 1826, while endeavouring to discover a Northwest Passage through the Canadian Arctic to the Orient. A preliminary analysis based on the results of these observations placed the magnetic pole in 70° N. Lat. and $98^{\circ} 30'$ W. Long., but a more detailed analysis by Professor Barlow placed the pole exactly where it was later found by Ross. Ross was probably the only scientist who has ever stood at the centre of the magnetic pole area. Observations of inclination made during a 24-hour period extending from noon June 1, 1831, gave a mean value of $89^{\circ} 59'$, only one minute short of the 90° which defines the pole. However, during the observing period values of inclination ranged between $89^{\circ} 56'$ and $90^{\circ} 3'$. The assumption that the magnetic pole actually was in the position determined by Ross is substantiated by a series of observations made during the previous winter in a temporary magnetic observatory at Victory Harbour and en route from Victory Harbour to Cape Adelaide Regina.

Modern Studies

The only way to fix accurately the position of the magnetic pole is to compute first a position using data from stations not too distant. The declination data will establish the centre of convergence of the magnetic meridians, the inclination data will establish the point where, the dip should be 90 degrees and the horizontal force data will establish its vanishing point. The next step is to surround the area indicated with magnetic stations which will further restrict the pole area. The mean pole point must then be found by an intensive ground survey in case the earth's field is deformed by the presence of certain geological formations.

All positions assigned to the north magnetic pole between 1904 and 1946 were computed principally from magnetic data applying to regions remote from the pole and mainly between 60° N. Lat. and 50° S. Lat. Eminent scientists in Great Britain, the United States of America and the U.S.S.R. have made careful analyses of such data and computed positions of primary and secondary poles ranging from three to eight hundred miles northerly from the 1904 position. These locations do not appear to be entirely valid when Canadian observations made north of 60° N. Lat. are taken into account. This statement does not discount the valuable contribution to the problem made by these scientists, who will be interested in revising their calculations in the light of recent Canadian observations.

The Division of Terrestrial Magnetism of the Dominion Observatory, Mines, Forests and Scientific Services Branch, Department of Mines and



Photos from Dominion Observatory, Ottawa.

Top: Paul H. Serson, of the Dominion Observatory, Ottawa, observing with a new type of induction magnetometer at Aberdeen Lake, N.W.T. Canada.

Centre: Dominion Observatory magnetic station at Agnew River, eastern Boothia Peninsula, N.W.T. Canada.

Bottom: Dominion Observatory magnetic station on a lake in the northern part of Prince of Wales Island, N.W.T., Canada. This is the closest station to the north magnetic pole.

Resources, has been responsible for conducting a systematic scientific magnetic survey of Canada since the Division was instituted in 1907. Since that time it has established over one thousand magnetic stations in Canada and Newfoundland. The Dominion Observatory early realized the importance of fixing the position of the north magnetic pole and decided that the best way to ensure this and at the same time provide accurate information for the construction of magnetic maps, was to extend the magnetic survey steadily and persistently northward until the entire country was covered by a network of base magnetic stations. The most strategic stations were to be reoccupied at intervals to gather secular change information.

The Dominion Observatory's network of magnetic stations was extended north of 60° N. Lat. to Great Slave Lake and the mouth of the Mackenzie in 1923 by French who travelled by canoe and Hudson's Bay Company river boats; to Nueltin Lake in 1922 by Madill using a canoe, to Hudson Strait in 1928 on C.G.S. *Montcalm*; to Ellesmere Island in 1934 on Hudson's Bay Company R.M.S. *Nascopie* and to Baker Lake and Repulse Bay in 1937 on the Company's vessels R.M.S. *Nascopie* and M.S. *Fort Severn*; to Coppermine and Cambridge Bay in 1945 by Serson using R.C.A.F. Canso and to Fort Ross in 1946 on R.M.S. *Nascopie*; to Denmark Bay in 1946 by Innes who travelled by snowmobile with Exercise Muskox; to northern Prince of Wales Island in 1947 by Serson and Clark using R.C.A.F. Canso; and to Slidre Bay, Eureka Sound, in 1947 by Cumming on board U.S.S. *Edisto*. In addition to the Dominion Observatory's stations, where values of declinations, inclination and force were measured, many declination stations were established north of 60° N. Lat. by officers of the Geodetic Service and Topographical Survey. Since 1943 magnetic observations have been made at 235 stations in this part of Canada.

The Dominion Observatory has been fully aware for many years that the north magnetic pole was travelling in a northerly direction. This was evident from a study of the results of observations made periodically at repeat stations extending from Newfoundland to Yukon. However, it was only after the completion of the work of the 1946 and 1947 field seasons that a position of the north magnetic pole could be indicated with some degree of assurance.

An examination of the information at hand following the close of the 1946 field season—which did not include any magnetic data north or west of Somerset Island—indicated quite definitely that the north magnetic pole was neither on Boothia Peninsula nor on Bathurst Island. The latitude of the pole was computed to be $73^{\circ} 15'$ N. Lat. There was more uncertainty regarding the longitude, as western and northern information were lacking

but a longitude of $94^{\circ} 30'$ N. appeared reasonable. This placed the pole in northwestern Somerset Island although there were indications that the pole might eventually be placed to the west of Peel Sound on Prince of Wales Island. It was therefore obvious that northern Prince of Wales Island must be investigated.

Observations During 1947

The 1947 plans comprised the establishing of magnetic stations in the Arctic islands to the north and west of Somerset Island. Stations to the south of Barrow Strait and Melville Sound were to be established by air and those to the north by water transportation.

The results of the 1947 season were most gratifying. The R.C.A.F. assigned a Canso amphibian aircraft to magnetic survey operations in the neighbourhood of the north magnetic pole. The captain of the aircraft was Flying Officer Drake and the navigator Flying Officer Goldsmith. Serson and Clark, geophysicists of the Division of Terrestrial Magnetism, Dominion Observatory, were responsible for carrying out the magnetic program. Despite extraordinarily adverse flying conditions, the magnetic survey of Canada was extended into areas heretofore untouched by scientists. Ice conditions were such as to prevent coastal landings and uncharted inland lakes were sought out and used. Abnormal fog conditions were the order of the day. The interest, experience and skill of the R.C.A.F. officers and crew members were exemplary with the result that a remarkably fine job was completed.

The standard types of magnetic instruments were used. They included a magnetometer for measuring declination and horizontal force, dip circle with intensity needles for measuring inclination and total force, and a transit with compass attachment for astronomical observations and auxiliary declination measurements. In addition, there was used for the first time in Canada an induction type magnetometer made up in the Division of Terrestrial Magnetism under the supervision of Serson. The detecting element was attached to the telescope tube of a transit instrument. The instrument measured declination, inclination and force and could be used for astronomical observations as well. The performance of the instrument was better than hoped for and it worked perfectly in regions of low horizontal force where the standard type magnetometer was useless.

Complete sets of magnetic observations were made at Allen Lake, north-eastern Prince of Wales Island; Guillemard Bay, southern Prince of Wales Island; Greely Haven, northeast Victoria Island; Cambridge Bay, southeast Victoria Island; Agnew River, eastern Boothia Peninsula; Tasekyoah Lake,

King William Island; and inland stations at Aberdeen Lake, Jolly Lake, Point Lake and Yellowknife.

Cumming, travelling by U.S.S. *Edisto*, covered the regions north of Barrow Strait and Lancaster Sound. Observations were made at Peddie Bay, southwest Bathurst Island; Freeman's Cove, southeast Bathurst Island; Resolute Bay, south Cornwallis Island; Port Leopold, northeast Somerset Island; Croker Bay, southern Devon Island; Olsen Island in Goose Fiord, southeast Ellesmere Island; Slidre Bay in Eureka Sound, northwestern Ellesmere Island; and Etah, Greenland.

The magnetic results obtained at these 18 stations which appear in Table 2, have provided information of great value in revising the position of the north magnetic pole. A complete solution will not be possible until magnetic stations have been established in northern Victoria Island, Banks Island, Prince Patrick Island, Melville Island and northwest Bathurst Island. Plans are now in a formative stage to establish magnetic stations on these islands in 1948. Reliable observations were made by Jackson, in 1908 and 1909, at a number of stations between Winter Harbour, Melville Island, and Point Hotspur, Bathurst Island, but secular change corrections must be applied before the results can be used in a rigid mathematical solution. These will not be available until new observations are made in the same area. However, certain information is available whereby declination values can be corrected to such a degree as to make them of use in the construction of preliminary charts.

Determination of the Position of the Magnetic Pole

Perhaps the quickest way to ascertain the approximate position of the north magnetic pole area is to construct magnetic meridians and find their point of convergence. The direction of the magnetic meridian at a station may be shown by a short straight line inclined to the true meridian by an angular amount equal to the declination. Each line will lie along or be tangent to a magnetic meridian. It is important that there should be a sufficient density of stations to enable the curvature of the meridians to be determined. Such a chart of magnetic meridians for a portion of northern Canada has been constructed from recent Canadian declination observations, which are represented by short arrows depicting the declination at magnetic stations. This chart (fig. 1) shows that the meridians converge toward an area in northern Prince of Wales Island. The centre of this area would occupy approximately the position of 73° N. Lat. and 100° W. Long. The area thus determined indicates the region in which a more detailed survey should be made. The accuracy of the delineation of magnetic meridians in the Canadian Arctic

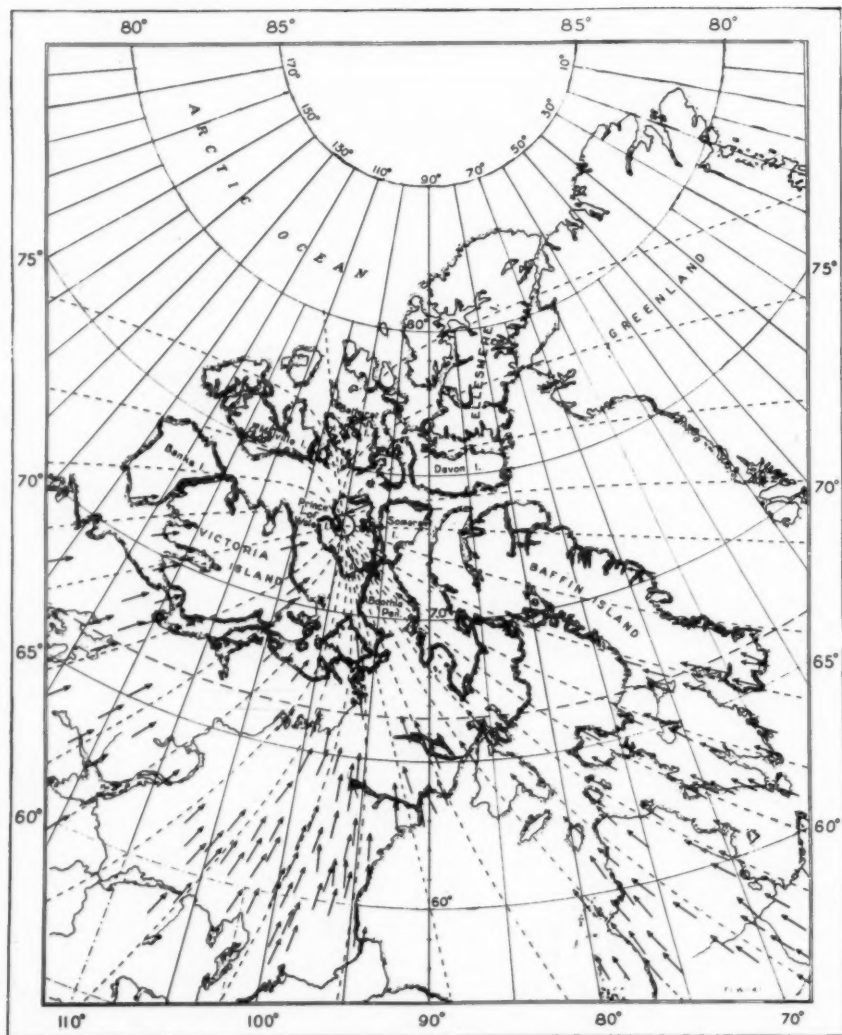


Fig. 1—Chart of magnetic meridians for a portion of northern Canada constructed from recent Canadian declination observations by the Dominion Observatory, Ottawa. The magnetic meridians converge on Prince of Wales Island where the region of the north magnetic pole as at present determined is shown by a circle.

archipelago suffers from a paucity of magnetic stations but it is believed that the meridians drawn on fig. 1 are reasonably correct.

Examination of declination data from northern Canada reveals some interesting coincidences. In the first place, the declinations seem to follow

TABLE 2

Preliminary values of declination (D) inclination (I) horizontal intensity (H) and total intensity (F) at magnetic stations, 1947.

STATION	LAT. N.		LONG. W.		D	I	H	F
	o	'	o	'	o	'	gammas	gammas
					West			
Etah.....	78	19	72	44	91	12	3691	55808
Croker Bay.....	74	33	84	21	.....	87	2801	57412
Slidre Bay.....	79	59	85	56	109	36	2532	56256
Olsen Island.....	76	27	88	42	.....	88	1978	56914
Port Leopold.....	73	52	90	17	94	50	1668	57722
Agnew River.....	70	38	92	35	55	27	1527	58637
Resolute Bay A...	74	41	94	50	101	10	892	57894
Resolute Bay B...	74	41	94	54	.....	88	1092	57698
Tasekyoah.....	68	52	96	37	11	48	1638	59772
Freeman's Cove...	75	12	98	04	128	33	675	57420
Guillemard Bay...	71	51	98	18	41	46	549	58604
Allen Lake.....	73	41	98	26	122	24	412	58287
					East			
Aberdeen Lake...	64	39	99	35	17	42	3589	60590
					West			
Peddie Bay.....	75	11	100	39	148	06	500	57938
					East			
Greely Haven.....	71	56	104	50	61	36	970	59122
Cambridge Bay...	69	07	104	57	35	09	2466	59810
Jolly Lake.....	64	08	112	04	35	37	6256	60473
Point Lake.....	65	21	113	40	40	18	5979	59922
Yellowknife.....	62	29	114	30	33	30	7754	59811

the trend of the coast lines or the general trend of the land masses towards the central part of the Arctic archipelago. It has been previously noted by the Division of Terrestrial Magnetism that acceleration and deceleration in secular variation in Canada are regional phenomena and apparently linked with broad geological formations. Again, it is remarkable that the magnetic meridian represented by a straight line running from the intersection of 60° N. Lat. and 90° W. Long. passes over Ross' position for the pole on Boothia Peninsula to the present indicated position. This line is in the same direction as the major axes of approximate ellipses denoting curves of equal horizontal force and inclination. It is of interest to note the coincidence between the direction of this meridian and the approximate north-south geographical axis of the Canadian Shield, north of 60° N. Lat. The writer has not the temerity to suggest at this time either that movement of the north magnetic pole may be constrained along a definite track or that the secular movement of the pole is controlled by changing conditions in that part of the earth's crust, nevertheless the coincidences are under review by the Division.

Complicated mathematical analyses of recent Arctic magnetic results, based on declination, inclination and horizontal force measurements, are now being made by the Division of Terrestrial Magnetism and show fairly conclusively that the north magnetic pole is in northwestern Prince of Wales Island, not far removed from 73° N. Lat. and 100° W. Long. This position is sufficiently accurate for all practical purposes, and a more refined value must await the conclusion of the 1948 investigations.

Work still remains to be done

The work of the Division of Terrestrial Magnetism in the Arctic will not be finished when the location of the magnetic pole is definitely established. The entire Canadian Arctic will be covered by an adequate network of base stations and sufficient magnetic observatories to control field observations. Future movements of the pole must be continually under review and there can be no cessation of effort until the Arctic is accurately charted; until it is fully understood why the north magnetic pole has been located in northern Canada at least since magnetic observations first were made and whether the pole is confined by geological barriers across which it can not pass.

ARCTIC INSTITUTE 1949 GRANTS-IN-AID

The Arctic Institute of North America has available a total of at least \$5000 for several senior grants-in-aid for scientific work in the North American Arctic and Subarctic during 1949. Research must include field investigations either in Alaska, northern Canada, Labrador, Newfoundland or Greenland.

The grants-in-aid are open to anyone who has demonstrated his ability to carry out research work of superior quality in some field of science.

Applications must be received by November 1, 1948. Grant-in-aid will be awarded on the recommendation of the Board of Governors of the Arctic Institute, and will be announced by March, 1949.

Application forms may be obtained upon application to: The Arctic Institute of North America, 805 Sherbrooke Street West, Montreal, Canada or Audubon Terrace, Broadway and 156th Street, New York 32, New York, U.S.A.

METEOROLOGICAL SERVICES IN ALASKA

By F. W. REICHELDERFER

Chief, United States Weather Bureau

THE present picture of meteorological services in Alaska is the result of expansion under wartime demands and development to meet the requirements of expansion of civilian aviation. Prior to World War II, the Weather Bureau maintained first-order stations at Juneau, Anchorage, Fairbanks, and Nome. In addition, second-order stations (noncommissioned personnel) were operated at widely separated points, such as Barrow, St. Paul Island, Attu, Dutch Harbor, Kodiak, Ketchikan, and Cordova, with on-call airway reporting stations at numerous villages in the Territory served only occasionally by air transportation.

Wartime Expansion of Services

As a result of wartime requirements, a considerable increase in the number of civilian-operated stations took place and second-order Weather Bureau stations at strategic points were converted into first-order stations, with further expansion of second-order station activities at additional points. There are now 15 first-order Weather Bureau stations in the Territory of Alaska, from which full 24-hourly service is available and from which 6-hourly synoptic and pilot balloon observations emanate. Six stations carry on radiosonde observations and six make rawinsonde observations of upper air conditions.

To serve wartime demands, Army and Navy meteorological offices were established at all points of operation by those agencies. The evolution of developments by civilian and military agencies has necessitated the establishment and operation of meteorological offices at all major centres of activity and at many intermediate points along established air routes between major stations. Furthermore, the Weather Bureau has assumed meteorological functions at several points now designated as second-order stations.

Meteorological facilities are maintained mainly by the U.S. Weather Bureau on the Alaskan mainland, while those on the Aleutian Chain are operated generally by the armed forces. Cooperating agencies, such as the U.S. Coast Guard and the Civil Aeronautics Administration, participate in the meteorological reporting program under Weather Bureau supervision. Reports are rendered by the U.S. Coast Guard from 10 stations in Southeastern Alaska and from 28 Civil Aeronautics Administration stations throughout the Territory. The armed forces function at 9 locations in the Territory of Alaska, primarily at points in the Aleutian Islands. Figs. 1 and 2 illustrate the distribution of the various reporting stations and Figs. 3-7 list these stations and the type and frequency of services rendered.

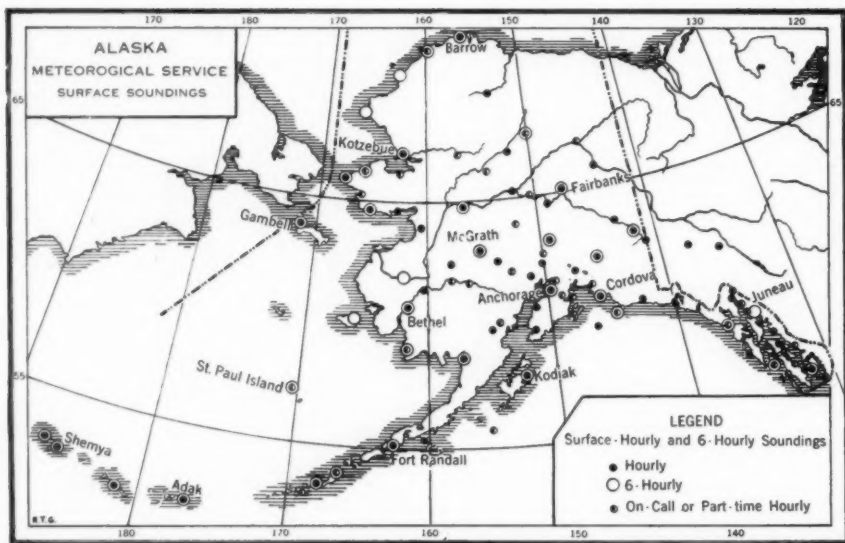


Fig. 1—Distribution of surface weather observations in Alaska.

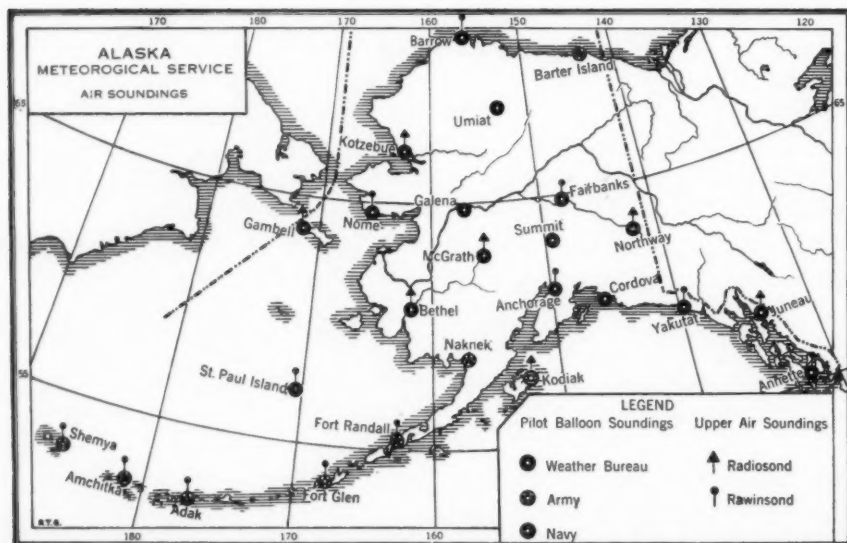


Fig. 2—Distribution of upper air observations in Alaska.

Radio Communication

All stations are served by radio communications and weather sequence collections and relays are accomplished by that medium. In addition, landline teletype circuits connect Anchorage, Fairbanks, and points along the Alaska Highway route with landline relay teletype points in the continental United States. Radioteletype circuits link several points in the Seward Peninsula and Norton Sound area with Anchorage to the southeast. Weather collections along the Aleutian Chain are by point-to-point radio facility into radio-teletype relay centres and thence to Anchorage. The Anchorage Civil Aeronautics Administration Communications Centre in turn maintains both radio point-to-point and radioteletype communication with the CAA Centre at Everett, Washington, for collection of material from the United States and relay of Alaskan reports. Similar communications link Anchorage with Honolulu for exchange of material with the Far East. Dissemination of meteorological material is accomplished to all stations on radio or radio-teletype circuits in Alaska and the Aleutians. In general, the major points of collection or distribution coincide with the location of forecast offices maintained by the U.S. Weather Bureau, the Army, and the Navy.

Forecast Centres

Of the 15 Weather Bureau Offices, three are major forecast centres, located at Anchorage, Juneau, and Fairbanks. Limited local forecasting is a part of the program of the Nome station also.

The Juneau Forecast Centre serves Southeastern Alaska from Dixon Entrance on the south to Whitehorse on the north and Yakutat on the northwest, issuing 6-hourly airway route and airway terminal forecasts and twice daily marine and general weather forecasts. Marine and general weather forecasts are broadcast over commercial radio stations for public consumption. Storm warnings are issued as required and broadcast for general public use.

The Anchorage Forecast Centre serves the north Gulf of Alaska, the Alaska Peninsula, the Aleutian Island, Bristol Bay, Kuskokwim Valley area, Cook Inlet, and Prince William Sound areas with 6-hourly airway route and terminal forecasts and twice daily marine and general weather forecasts. The marine and general weather forecasts are broadcast over commercial radio stations for general public consumption. Storm warnings are issued as required and broadcast for public information. Fire weather forecasts are issued seasonally.

The Fairbanks Forecast Centre serves the interior of Alaska, the north and northwest coasts of Alaska, the Seward Peninsula, Norton Sound and Kotzebue Sound areas with 6-hourly airway route and terminal forecasts

FIG. 3.—FIRST ORDER WEATHER BUREAU STATIONS

STATION	LAT.	LONG.	DESIGNATOR	OBSERVATIONAL PROGRAM							
				Hourly	Additive Data		Synoptics		Pibals	Radiosonde	Rawinsonde
					6-Hourly	3-Hourly	Synoptics				
							6-Hourly	6-Hourly			
Anchorage (Merrill).....	60° 13' N	149° 50' W	HQ	24	4	4	4	2	..	2	
Barrow.....	70 18'	156 47'	WY	24	..	4	4	2	..	2	
Bethel.....	60 47'	161 41'	UB	24	..	4	4	4	2	..	
Cordova.....	60 29'	145 30'	KA	24	4	4	4	4	..	..
Fairbanks (Weeks).....	64 50'	147 43'	FX	24	4	4	4	2	..	2	
Galena.....	64 43'	156 54'	GQ	24	4	4	4	4	..	..
Gambell.....	60 47'	161 41'	WK	24	..	4	4	4	2	..	
Juneau.....	58 22'	134 35'	JE	24	4	4	4	4	2	..	
Ketchikan (Annette).....	55 02'	131 35'	UKG	24	4	4	4	2	..	2	
Kotzebue.....	66 52'	162 38'	KP	24	4	4	4	4	2	..	
McGrath.....	62 58'	155 37'	WH	24	..	..	4	4	2	..
Nome.....	64 30'	165 24'	YO	24	4	4	4	2	..	2	
Northway.....	62 58'	141 58'	PM	24	4	4	4	4	2	..	
St. Paul Island.....	57 09'	170 13'	PI	..	..	..	4	2	..	2
Wales.....	65 37'	168 03'	WN	24	4	4	4	2	..	..

FIG. 4—SECOND ORDER WEATHER BUREAU STATIONS

STATION	LAT.	LONG.	DESIGNATOR	OBSERVATIONAL PROGRAM						RADIOSONDE	RAWINSONDE		
				HOURLY	ADDITIVE DATA		SYNOPTICS		PIBALS				
					6-Hourly	3-Hourly	6-Hourly	6-Hourly					
Angoon.....	57° 30'N	134° 35'W	HKN	10	None	None	..	..	None	None	None
Candle.....	65 56'	161 55'	HEX	12	"	"	"	"	"	"	"		
Circle.....	65 48'	144 04'	HAO	4	"	"	"	"	"	"	"		
Craig.....	55 29'	133 09'	HAZ	9	"	"	"	"	"	"	"		
Crooked Creek.....	61 52'	158 15'	HAZ	5	"	"	"	"	"	"	"		
Curry.....	62 37'	150 02'	HEC	10	"	"	"	"	"	"	"		
Flat.....	62 29'	158 05'	HFL	12	"	"	"	"	"	"	"		
Hughes.....	66 04'	154 15'	HHU	12	"	"	"	"	"	"	"		
Manley Hot Springs.....	65 00'	150 39'	UMS	12	"	"	"	"	"	"	"		
Mountain Village.....	62 07'	163 45'	HMZ	0	"	"	4	4	"	"	"		
Nunivak.....	60 12'	166 08'	UNN	0	"	"	4	4	"	"	"		
Palmer.....	61 36'	149 07'	HDT	3	"	"	"	"	"	"	"		
Platinum.....	59 01'	161 47'	UPL	10	"	"	4	4	"	"	"		
Point Hope.....	68 20'	166 48'	HDO	"	"	"	4	4	"	"	"		
Point Lay.....	69 49'	162 55'	HPY	"	"	"	"	"	"	"	"		
Portage.....	60 50'	148 59'	HAP	12	"	"	"	"	"	"	"		
Puntilla.....	62 09'	152 50'	HDY	14	"	"	"	"	"	"	"		
Seward.....	60 07'	149 27'	HSW	12	"	"	"	"	"	"	"		
Shishmaref.....	66 14'	166 07'	HFV	5	"	"	3	3	"	"	"		
Skagway.....	59 27'	135 19'	USG	10	"	"	"	"	"	"	"		
Stony River.....	61 46'	156 38'	HDE	7	"	"	4	4	"	"	"		
Tanalian Point.....	60 13'	154 22'	HGT	10	"	"	"	"	"	"	"		
Teller.....	65 16'	166 21'	HAT	5	"	"	"	"	"	"	"		
Tenakee.....	57 47'	135 12'	HET	6	"	"	"	"	"	"	"		
Valdez.....	61 07'	146 16'	HDZ	9	"	"	"	"	"	"	"		
Wainwright.....	70 38'	159 50'	HWX	3	"	"	4	4	"	"	"		
Wiseman.....	67 26'	150 13'	HFZ	13	"	"	2	2	"	"	"		
Wrangell.....	56 28'	132 23'	HLL	9	"	"	"	"	"	"	"		

FIG. 5—SECOND ORDER WEATHER BUREAU STATIONS (CAA)

STATION	LAT.	LONG.	DESIGNATOR	OBSERVATIONAL PROGRAM						RADIOSONDE	RAWINSONDE
				HOURLY	ADDITIVE DATA		SYNOPTICS	PIBALs			
					6-Hourly	3-Hourly						6-Hourly
Aniak.....	61° 40'N	159° 42'W	NZ	24	4	4	None	None	None	None	
Beetles.....	66 54	151 50	KE	24	4	4	"	"	"	"	
Big Delta.....	64 00	145 44	JQ	24	4	4	"	"	"	"	
Farewell.....	62 32	154 03	LU	24	4	4	"	"	"	"	
Fort Yukon.....	66 35	145 18	FD	14	4	3	"	"	"	"	
Gulkana.....	62 09	145 28	XV	24	4	4	"	"	"	"	
Gustavus.....	58 25	135 42	NE	24	4	4	"	"	"	"	
Haines.....	59 13	135 26	VN	24	4	4	"	"	"	"	
Homer.....	59 38	151 31	RM	24	4	4	"	"	"	"	
Iliamna.....	59 44	154 57	JP	24	4	4	"	"	"	"	
Kenai.....	60 33	151 16	JS	24	4	4	"	"	"	"	
Lake Minchumina.....	63 53	152 17	IQ	24	4	4	"	"	"	"	
Middleton Island.....	59 28	146 19	IJ	24	4	4	"	"	"	"	
Moses Point.....	64 43	162 05	HG	24	4	4	"	"	"	"	
Nenana.....	64 33	149 06	NG	24	4	4	"	"	"	"	
North Dutch Islands.....	60 46	147 49	DO	11	4	1	"	"	"	"	
Petersburg.....	56 49	132 57	UJ	24	4	4	"	"	"	"	
Port Heiden.....	56 57	158 39	ZG	16	3	2	"	"	"	"	
Sheep Mountain.....	61 48	147 41	SG	24	4	4	"	"	"	"	
Sitka.....	57 03	135 21	SK	24	4	4	"	"	"	"	
Shungnak.....	66 54	157 02	NL	14	4	3	"	"	"	"	
Skwentna.....	61 57	151 13	RJ	24	4	4	"	"	"	"	
Summit.....	63 20	149 09	JD	24	4	4	"	"	"	"	
Talkeetna.....	62 19	150 06	AO	24	4	4	"	"	"	"	
Tanacross.....	63 23	143 19	TW	24	4	4	"	"	"	"	
Tenana.....	65 10	152 06	KZ	24	4	4	"	"	"	"	
Unalakleet.....	63 54	160 47	UW	24	4	4	"	"	"	"	
Yakataga.....	60 02	142 28	ZZ	24	4	4	"	"	"	"	

FIG. 6—SECOND ORDER WEATHER BUREAU STATIONS (USCG)

FIG. 6—SECOND ORDER WEATHER BUREAU STATIONS (USCG)

STATION	LAT.	LONG.	DESIGNATOR	OBSERVATIONAL PROGRAM					
				HOURLY	ADDITIVE DATA		SYNOPTICS	PIBALS	RADIOSONDE
					6-Hourly	3-Hourly			
Cape Decision.....	56° 00'N	134° 08'W	HCD	4		None	4	None	None
Cape Hinchinbrook.....	60 14	146 39	HAQ	4		"	"	"	"
Cape Spencer.....	58 12	136 38	HRB	4		"	4	"	"
Cape St. Elias.....	59 48	144 36	HEA	4		"	4	"	"
Eldred Rock.....	58 58	135 13	HEL	4		"	"	"	"
Five Finger Light.....	57 16	133 37	HFP	4		"	"	"	"
Guard Island.....	55 27	131 53	HGI	4		"	"	"	"
Lincoln Rock.....	56 04	132 42	HLR	4		"	"	"	"
Point Retreat.....	58 25	134 57	GVD	4		"	"	"	"
Tree Point.....	54 48	130 56	HFT	4		"	"	"	"

FIG. 7—ARMED FORCES WEATHER STATIONS

STATION	LAT.	LONG.	DESIGNATOR	OBSERVATIONAL PROGRAM					
				HOURLY	ADDITIVE DATA		SYNOPTICS	PIBALS	RADIOSONDE
					6-Hourly	3-Hourly			
Adak (Army-Navy).....	51° 53'N	176° 38'W	NCI	24	4	4	4	2	2
Amchitka (Army).....	51 24	179 16 E	CH	24	4	4	4	2	2
Attu (Navy).....	52 53	172 31 E	GCW	24	4	4	4	4	"
Fort Glenn (Army).....	53 23	167 54 W	RS	24	4	4	4	2	2
Fort Randall (Army).....	55 12	162 43 W	DI	24	4	4	4	2	2
Kodiak (Navy).....	57 45	152 31 W	NHB	24	4	4	4	4	"
Naknek (Army).....	58 41	156 40 W	KD	24	4	4	4	4	"
Shemya (Army).....	52 43	174 06 E	PF	24	4	4	4	2	2
Yakutat (Army).....	59 31	139 40 W	UVY	24	4	4	4	2	2

and twice daily marine and general weather forecasts. General weather forecasts are broadcast for public use over commercial radio facilities. Marine forecasts issued for the Seward Peninsula section are disseminated in that area. Storm warnings are issued as required and broadcast for public information. Fire weather forecasts are issued seasonally.

The Nome station functions in part as a minor forecast centre serving aviation activities and general public service requirements in the Seward Peninsula section.

Facilities at Airports

Under prewar conditions, meteorological reporting activities were seriously hampered by inadequate communication facilities, but under wartime demands these shortcomings were eliminated along the main lines of transportation where airports of sufficient size for multimotored aircraft were constructed.

Major airports from which originate meteorological data are located along the coastal route bordering the Gulf of Alaska. Surface meteorological observations are available at such stations 24 hours a day, pilot balloon soundings 2 or 4 times daily, and, at widely separated points, radiosonde or rawinsonde upper air soundings twice daily. Similar developments occurred along the routes from Anchorage to Fairbanks to Barrow, from Nome to Fairbanks to Northway and Whitehorse, and from Bethel to McGrath to Fairbanks.

In the early days of the war, first order Weather Bureau stations were established at Barrow, Kotzebue, Gambell, Bethel, McGrath, Northway, Summit, and Ketchikan. Programs consisting of surface airway weather observations, synoptic (6-hourly) reports, pilot balloon and radiosonde observations at those named stations were developed to their present level of operations, bringing the distribution of meteorological reporting stations to a level consistent with service demands.

BIBLIOGRAPHY AND ROSTER PROJECT

The Arctic Institute is compiling a comprehensive bibliography of arctic literature, set up as a three year project involving a staff of six workers under the direction of Marie Tremaine, formerly Associate Head of the Reference Section of the Toronto Public Library. Present headquarters of the project are at the Library of Congress, Washington, D.C.

The Institute is also engaged in preparing a roster of arctic specialists. This project is under the direction of Dudley Smith with headquarters at the Carnegie Institute, Washington, D.C. The cost of the two projects is being borne by the U.S. Office of Naval Research, U.S. Army and the Canadian government.

THE DANISH METEOROLOGICAL SERVICE IN GREENLAND

By HELGE PETERSEN

Director of the Danish Meteorological Institute

SINCE the establishment of the Danish Meteorological Institute in 1872 a regular meteorological service has been maintained in Greenland, and from 1873 on climatic data from Greenland have to an ever increasing extent been published in the Institute's Yearbooks.

Location of Stations

During the first twenty years, Greenland Meteorological stations were all situated on the west coast. This was due to the fact that navigation of the east coast during the greater part of the year is practically impossible on account of the masses of ice, the so-called *Storis* ("big ice"), accumulating in the sea outside. Angmagssalik, the first settlement on the east coast, was established in 1894. Regular meteorological observations are dependant on a fixed population; as the east coast, in contrast to the west coast, has a very sparse population, the establishment of meteorological stations there has only been made possible gradually as settlements (Angmagssalik and Scoresbysund) came into existence. When, owing to the development of the meteorological service, additional observations became important, settlements were established for the sole purpose of providing meteorological observations. These are the east coast stations shown on Fig. 1. In the early days observations were undertaken by the local Danish officials; subsequently it proved possible to let the natives, as they began to participate in the administration of Greenland, take part in this work too.

In considering the extent of the network of meteorological stations and their location, it should be borne in mind that in so sparsely populated a country it is not always possible to locate stations where the meteorologists would like them. The first step is to find places with a settled population sufficiently large to ensure that observations are taken regularly. The location of a station is thus primarily contingent on there being favourable conditions for habitation. This may lead to observations, in particular of such elements as temperature and wind, being unrepresentative of a large area. For example, these elements are very frequently different at the mouth and at the inner end of the numerous long fiords. A very dense network of stations in Greenland will, therefore, only be of interest as providing details of the local climate.

The number of climatic stations in Greenland was:

- 1873: 4 (on the west coast).
- 1900: 9 (one of which was on the east coast).
- 1925: 12 (two of which were on the east coast).
- 1939: 16 (two of which were on the east coast).

Observations from climatic stations in Greenland are published in Annual Reports of the Danish Meteorological Institute, (Part 11). Comprehensive climate descriptions are to be found in the work: *Greenland*, published by the Commission for the Direction of the Geological and Geographical Investigations of Greenland. Vol. I 1928. (C. A. Reitzel, Copenhagen, and Humphrey Milford, London), and in: W. Köppen und R. Geiger: *Handbuch der Klimatologie*, Bd. II, Teil K. 1935 (Gebrüder Borntraeger, Berlin).—Special Climatic reports are to be found in the series: *Meddelelser om Grønland*, (C. A. Reitzel, Kobenhavn).

In addition to these long periods of observations, which in the case of some stations are for 75 years, a great number of earlier observations have been taken since the end of the eighteenth century, but only for short periods of a few years.

Terrestrial Magnetism

Greenland is of special interest on account of its favourable position for the investigation of earth magnetism. Because of this a permanent magnetic observatory with complete recording equipment was established in 1926 at Godhavn on Disko Island off the station of Jakobshavn. Since its establishment the Observatory has been operated without interruption. Observations are published in the Danish Meteorological Institute's Magnetic Yearbook for Godhavn.

Radio Transmission Begins

The establishment of radio stations in Greenland for the purpose of communicating with Denmark, made it possible to send meteorological data for use in the synoptic service. Special transmitting stations were therefore established in 1926 and 1927 at *Godhavn*, *Godthaab*, and *Julianehaab* on the west coast and at *Angmagssalik* and *Scoresbysund* on the east coast.

This service did not work very satisfactorily because of unfavourable conditions. The southern tip of Greenland is situated in the area with the greatest frequency of aurora borealis, and because of this radio connection with Denmark was very often rendered ineffective, and this caused a delay in reception of the messages. Apart from this, communication at that time was a long way from the degree of perfection which it has since attained. Finally the synoptic service in those days was not as important as it is today, so the demand for Greenland observations was then, though fully justified, less widespread.

The enormous development of air traffic has however altered the picture out of all recognition. During the war Denmark was prevented from taking any steps in Greenland to keep up with this development. But since the end



Above: Interior of terrestrial magnetism observatory, Godhavn, Disko, Greenland.



Above: Danish meteorological station, Thule, Greenland, with Thule Fjeld in the background.



Left: Release of radiosonde instrument at Thule, Greenland.

Photos: Danish Meteorological Institute.

of the war Denmark has undertaken the task of providing meteorological observations from Greenland to the extent deemed necessary.

Distribution of Synoptic Stations

The earliest synoptic stations in Greenland, established in 1926, were not at first run in connection with the existing climatic stations. For practical purposes it was found better that the personnel of the radio station, who were to transmit the reports, should also act as observers. This practice of keeping the synoptic and the climatic stations apart has been followed ever since.

It would be extremely difficult to state exactly how many synoptic stations there should be in Greenland to provide adequate coverage. If Greenland, was to have the same density of stations, in proportion to its area, as countries in lower latitudes, the number of stations would admittedly be very high. However, this would not be practicable for the very reason that only a narrow coastal strip is habitable. To establish a permanent station on the inland ice is a hazardous enterprise which would not be justified, however interesting it might be from a scientific point of view.

Therefore, at least for the present, we are only concerned with stations in the coastal districts which are indented by many long fiords. The stations which broadcast internationally are shown on Fig. 1. It is noticeable that there are far more stations on the west coast than on the east coast. This is for reasons already mentioned, that the west coast is more easily accessible than the east coast, coupled with the fact that climatic conditions make the west coast more fit for human habitation. It has been possible to establish stations on the west coast in places already inhabited, whereas several stations on the east coast have no other inhabitants than those who run the meteorological station. It goes without saying that it is extremely difficult to run a station under such conditions.

Influence of Local Conditions

An outstanding feature of Greenland stations is that at practically all of them the meteorological conditions are greatly influenced by local factors. Nothing can be done to alter this state of affairs, it being due to topographical conditions, but it is important that this be emphasized to enable a reliable estimate of the value of the observations.

The observations most influenced by local conditions are those of the wind, which both as regards direction and force may differ greatly from the conditions met with over the sea off the coast. The station may for instance be sheltered so that the indicated wind force is too low or the station may be exposed to a strong local wind which may not reach the sea. Stations situated on a long fiord experience as a rule only winds blowing

in and out of the fiord; the direction of the wind may, therefore, often deviate radically from the direction of the wind indicated by pressure conditions.

With regard to observations of temperature it should be remarked that foehn winds occur comparatively frequently in Greenland; these winds may give rise to so rapid local variations in the temperature (up to 20°C in the course of 24 hours) that the observations are entirely devoid of any synoptic significance. Only pressure observations may be assumed to be entirely unaffected by local conditions and must consequently be regarded as the observations which can most reliably be fitted into the synoptic network of stations. These conditions typical of the Greenland stations have been more elaborately dealt with in Köppen und Geiger's *Handbuch der Klimatologie* mentioned above. However, it is intended whenever practicable, to move stations which are most strongly influenced by unfavourable conditions to nearby places, where the meteorological observations may be expected to be more representative of the conditions in the free atmosphere.

The meteorological data comprise of course primarily the normal surface observations, atmospheric pressure, temperature, etc., which are taken eight times in every 24 hours at the hours recommended internationally. To these are added upper air observations, viz., Pibal observations at most stations and radiosonde observations at some stations, a few of which also take rawin observations. When all the stations have seen establishment, it is planned to operate six radiosonde stations in all; these are to be distributed along the entire coast line from Thule in the north-west to Danmarkshavn in north-east. This service is, however, confronted with the difficulty common to arctic stations, of providing hydrogen for the balloons. It is intended to limit the number of ascents to two in every 24 hours, but even with this restriction the consumption of hydrogen will be



Map from Danish Meteorological Institute.

Fig. 1—Distribution of Danish meteorological stations in Greenland, December, 1947.

so large that it appears to be most practical to manufacture the hydrogen at each station.

All existing plants for the manufacture of hydrogen contain water and require absolutely frost-free conditions. If freezing occurs in the course of the winter, it will make continuance of the upper air service difficult. But it is hardly possible to ensure absolutely frost-free conditions in Greenland without unreasonably extensive measures being taken. Consequently the task of providing upper air observations there as regularly as from stations in lower latitudes is at present extremely difficult, and it is to be expected that it will take some time to find a really practical solution of all the problems involved.

Difficulties of Radio Transmission

When in 1926 Denmark commenced transmitting synoptic messages from Greenland to meteorological institutes all over the world, it was hailed as a great step forward. But the difficulties of transmission over such large distances as from Greenland to Denmark were then so great that the messages were often received too late to be used for forecasting. The cause of the difficulty is not only the long distances, as has been mentioned, there is the fact that the south point of Greenland is situated exactly in the area with the greatest frequency of auroras with the attendant magnetic disturbances. This gives rise to frequent irregularities in transmission. In periods of sunspot maximum, even though the most modern technical equipment is used, the connection may be broken off completely and not be re-established until conditions in the ionosphere have again calmed down. To ensure that such interruptions do not occur, it will be necessary to have available long, as well as short wave lengths for transmission.

Finally, experience since 1926 both with the service in Greenland and from radio communication with ships operating in Greenland waters has shown that Greenland itself exerts a great influence on transmission conditions, and this has to be taken into account when the transmission system is being set up.

In the planning and developing of the radio system Denmark has been able to exploit fully the experience accumulated in the course of the preceding twenty years. Owing to the difficulties at present prevailing everywhere with regard to securing technical equipment of every description, it will take some time before the task is completed, but it is now possible under favourable conditions to get 90-100 per cent of the observations to Denmark in time.

Greenland observations are broadcast internationally, primarily in "Meteo Danois" which is broadcast 8 times every 24 hours (for further

details see international circulars). In order to ensure that the Greenland messages, which are of very great importance to Atlantic air traffic, are received by the terminal airports without delay, on being received at Copenhagen they are immediately sent by cable to B.A.F.O. in Frankfurt a.M. and are thus fed into the international meteorological communication system.

Plans for a Complete Network of Stations

During several centuries Denmark has acquired great experience both in navigating Greenland waters under difficult conditions and in providing the best possible living conditions for people living under the often extremely unfavourable climatic conditions found in Greenland. It may, therefore, be assumed that Denmark will be capable of maintaining in Greenland a network of synoptic stations of as permanent a character as is at all possible. Because of the abnormal conditions prevailing all over the world at present it must necessarily be some time before the system is fully established and can operate with complete efficiency.

Below: United States Air Force airport Bluie West One, Narsarsuaq, Greenland. This wartime ferrying airport lies at the inner end of Tunugdliarfik Fjord, southwestern Greenland. Nearby are ruins of Norse settlements. The ice cap lies beyond the mountains in the background of the photograph.

Photo: United States Air Force.



THE GROWTH OF METEOROLOGICAL KNOWLEDGE OF THE CANADIAN ARCTIC

By ANDREW THOMSON, M.A., O.B.E., F.R.S.C.

Controller, Meteorological Division, Department of Transport

COLD waves, the periodic surge of Arctic masses into the main west-east flow of air in the temperate latitudes, emphasize the indispensable need of the meteorologist for data from Canada's remote northland. A day-by-day knowledge of changes in the Arctic is vital to the interpretation of changes in more temperate latitudes. The advancement of his profession and of the science depend to a large extent on an increased understanding of arctic meteorology.

Almost a quarter of the Arctic cap is Canadian territory (see Fig. 1), an area second only to that controlled by the U.S.S.R. Canada thus carries an international obligation to roll back the meteorological frontiers of the Arctic, for the free exchange of weather data between nations of the northern hemisphere is no longer a courtesy but a scientific necessity. The discharge of this responsibility over a period of two centuries is a romantic and challenging chapter in Canadian history.

While the Arctic is traditionally bounded on the south by the sixty-sixth parallel, considerations of logistics, density of population and nature of the terrain suggest a modification of this definition to include an area which, for purposes of this article, may be designated as the Subarctic. This area lies between the Arctic Circle and an irregular line, roughly along the sixtieth parallel. The term "Arctic" is used loosely in the following article to include both the Subarctic and the true Arctic, in the Canadian sector.

Exploration and Meteorological Observations

As might be expected, the history of meteorological observations in the Canadian Arctic is closely related to the history of exploration. This chronicle of discovery, it must be assumed, is entirely familiar to readers of *Arctic*. While there is some evidence that Leif Ericson discovered Baffinland in the year 1000 A.D., the usual date of the opening of the Arctic is given as 1576, when Frobisher reached the same island. There follows a succession of names—Davis, Hudson, Button, Baffin, Hearne, Mackenzie, Scoresby—each contributing either directly or indirectly to the early meteorological knowledge of the Arctic. In a later period, even greater contributions were provided by the scientific, rather than purely exploratory, expeditions of Parry, Ross and Franklin.

The first organized effort to make meteorological observations in the entire Arctic, including the Canadian sector, came with the establishment of

a Polar Year, August 1882 to August 1883. In the succeeding forty years, famous names, such as Greely, Nansen, Sverdrup, Stefansson, Amundsen, Bernier and Peary, were entered on the Arctic roster. The highlight of the remaining two decades was the organization of a second Polar Year in 1932-33.

Early Arctic Observations

One of the earliest instrumental records in northern Canada was made by Mr. Thomas Hutchins, an officer of the Hudson's Bay Company at York Factory and Severn House, in 1772-73.¹ These short-term instrumental records, together with references to the character of the seasons, drought, snowfall and other climatic phenomena, indicate that during the 18th and 19th centuries the general character of seasonal variations was much the same as during the present century.

An important contribution to our knowledge of the meteorology of the arctic regions is provided by a publication² under the authority of the Meteorological Council of Great Britain, printed in the years 1879-1888. Meteorological observations are here recorded from no less than thirty-six expeditions dating from 1819-1858, almost all arising out of the tragic search for Franklin. Four sets of the land-station observations (1845-1854) are a tribute to the indefatigable scientific work of Dr. John Rae, Hudson's Bay factor.

On these searching expeditions, observations were taken for the most part 2-hourly, some hourly, and the others, three, six, eight times a day. The length of the records varies from eight months to twenty-seven months. Observations were generally taken of temperature, including that of the sea, pressure, wind, weather, character of the cloud, thickness of the ice, and in some cases solar radiation.

Establishment of Arctic Stations

The Canadian Meteorological Service (established in 1839) is also indebted for its Arctic data to the factors of the Hudson's Bay Company, to the missionaries of the Roman Catholic Church and of the Church of England, and to members of Canadian surveying parties, as well as to explorers.

During the first Polar Year³ in 1882-83, three Arctic stations were organized. Canada and Great Britain jointly managed the station at Fort Rae, Great Slave Lake. The United States made a major contribution to the success of the Polar Year when Lieut. Greely⁴ established a base at Fort

¹A. J. Connor, "Canada", Handbook of Climatology, Köppen and Geiger, Vol. 2, Part J.

²"Contributions to our Knowledge of the Meteorology of the Arctic Regions", Vol. I, H.M. Stationery Office, 1885.

³J. Patterson, "A Century of Canadian Meteorology", Q. J. Roy. Met. Soc., Vol. 66, Supp. 1940.

⁴Canadian Geographic Journal, Vol. XXX, No. 3, March 1945, p. 144.

Conger on northern Ellesmere Island. The third station was undertaken by the Germans at Kingua Fjord, Cumberland Sound, Baffin Island.

In 1880 the young nation of Canada awoke to the fact that her northern boundaries were only vaguely defined. Accordingly, at her request, the British Government confirmed the transfer to the Dominion of all the Arctic Islands adjacent to the Canadian mainland. The first Dominion exploration party was concerned with the investigation of the Hudson Bay route. Seaborne expeditions went north to Hudson Strait in 1884, 1885 and 1886,⁵ and maintained meteorological stations at several points during the two intervening winters.

In 1898, observations were commenced at Dawson in the Yukon. In 1909, a chain of stations was opened along the Mackenzie River to Fort McPherson in the Mackenzie Delta, while a few years earlier observations had been taken on Herschel Island by Bishop Stringer. It is of interest to note that Sir Frederick Stupart, who became Director of the Meteorological Service⁶ in 1894, spent the period from July 1884 to November 1885 on an inlet, called in his honour "Stupart Bay", systematically recording weather conditions and the presence and motion of ice floes.

During the period of discovery from 1576 to 1902, there were no less than 49 British expeditions, 13 United States, one Danish and one Norwegian expedition to the Arctic. While the number of expeditions after the turn of the century decreased, their intensity and scope increased, and the Arctic annals record the famous voyages of Ziegler, Stefansson, Sverdrup, Bernier and Amundsen. Names such as Pond Inlet, Winter Harbour, Arctic Bay and Eureka Sound, now prominent in Arctic lore, assume an additional atmosphere of romance when it is realized that temporary settlements were first made in these isolated spots a half century ago.

Hitherto the discussion has been limited to meteorological observations taken at the surface. The first upper-air observations taken in the Canadian Arctic⁷ appear to have been made in 1822-23 by Rev. George Fisher and Sir Edward Parry. These men sent aloft, on kites, self-registering thermometers, duly recording that the air was isothermal to 400 feet with a temperature of -24°F . This observation was apparently made at latitude $69^{\circ} 21'\text{N}$, longitude 124°W . It was not until the second Polar Year more than a century later that further upper-air ascents in the Arctic were recorded. In 1932, at both Coppermine and Chesterfield, kite ascents were made, and in 1933 the first radiosonde was launched in the north at Coppermine. In 1936 at Fort

⁵"Report of the Hudson's Bay Expedition", 1884-5-6, Lt. A. R. Gordon, R.N., Canadian Government Reports.

⁶Jnl. Roy. Astronomical Soc. of Canada, Vol. 35, p. 137.

⁷Sir Napier Shaw, "Manual of Meteorology", Vol. I, p. 207.

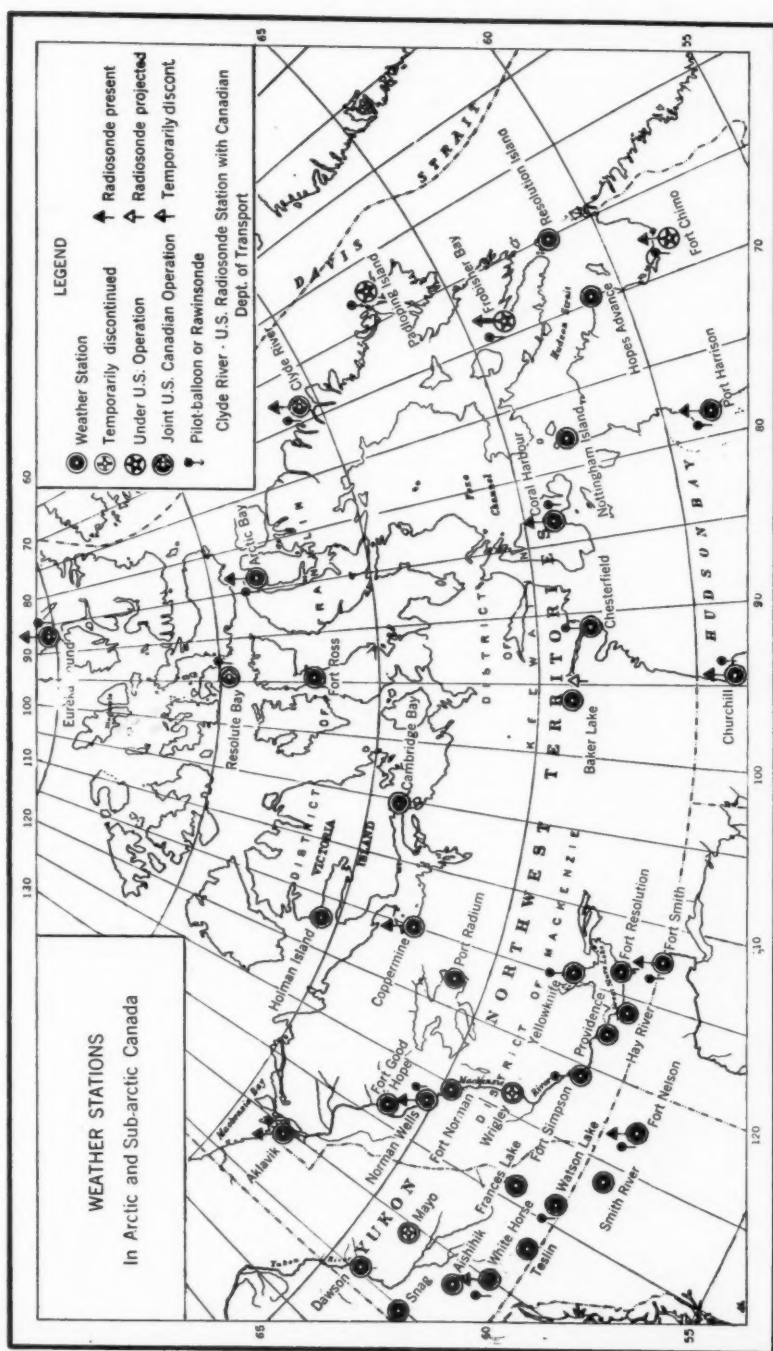


Fig. 1—Distribution of Arctic and Subarctic weather stations in Canada, January, 1948.

Smith extensive aircraft upper-air ascents were made, and in 1942 Aklavik was inaugurated as the first continuously reporting upper-air station in the Canadian Arctic.

The second International Polar Year was organized at the International Meteorological Organization Conference at Copenhagen in 1929, to celebrate the fiftieth anniversary of the first Polar Year. Canada played a more prominent role than formerly, maintaining four stations: Cape Hopes Advance (Quebec), Chesterfield Inlet, N.W.T., Coppermine, N.W.T., and Meanook (Alberta). In addition, the British took observations for that year at Fort Rae, the same site at which they and the Canadians had operated during the first Polar Year.

Development of Arctic Communications

Dating from the 1880's, a series of meteorological stations was progressively opened in the Arctic. It is interesting to note the dates and the records of some of these stations which do not appear on the current roster: Fort McPherson (1909-38), Lake Harbour (1909-37), Fort Hope (1891-1921), Hebron, Labrador (1884-1910), Herschel Island (1899-1918), York Factory (1899-1914), Carcross (1907-42), Swede Creek, Yukon (1918-28). However, most of these stations took reports for climatological records only. Owing to a lack of rapid communication, the reports were of course of no use for current synoptic purposes.

It was in the 1920's that a chain of government wireless stations was first begun in the Northwest Territories. In those early years the stations were primarily for the gathering and transmitting of meteorological data for the Canadian Meteorological Division, but they handled commercial messages as well. By 1941, besides a dozen stations maintained by the government, all the larger Hudson's Bay Company trading posts in the Northwest Territories had short-wave key and telephone transmitters, while flying and mining companies had radio equipment wherever it was needed.

The period of modern meteorological observations can be said to date from the introduction of the radio in the North. Observations are now taken not only by personnel of the Meteorological Division but by those of the Royal Canadian Corps of Signals, the Radio Telegraph Branch of the Department of Marine, the Royal Canadian Mounted Police, Hudson's Bay factors, missionaries, and employees of commercial and mining companies.

Wartime Expansion of Observing Network

The outbreak of war in 1939 involved the Meteorological Division in many new tasks, among them the difficulty of maintaining an expanded network of far northern stations. Military flying mushroomed, and civil aviation continued its rapid growth. At this stage the outstanding deficiency of the



Photos: National Film Board, Canada.

Top: Observer at Radiosonde station, Arctic Bay, Baffin Island, Canada, releasing meteorological balloon.

Bottom: Staff Sergeant of the Royal Canadian Corps of Signals recording temperature observations at a Mackenzie Valley weather station, N.W.T., Canada.

observational network throughout Canada—in the south as well as in the north—was the scarcity of upper-air data, especially temperatures and humidities. The recent development of an extensive radiosonde network in the United States and Alaska had shown the value of such observations. To meet this need for upper-air data, development work on a Canadian radiosonde was pushed to completion and mass production was begun on a scale which made possible the establishment of regularly reporting radiosonde stations by 1941. During this period of conversion to a wartime footing the Division began surface observations at Whitehorse Airport and Holman Island and re-opened the station at Cambridge Bay.

The entry of the United States and Japan into the war in 1941 marked the real beginning of wartime expansion of Canadian meteorological services in the Arctic. Aircraft in an ever-increasing stream were ferried to Alaska, the Aleutians and the U.S.S.R. by way of northwestern Canada, and to the United Kingdom, Iceland and Greenland by way of Newfoundland, Labrador and northeastern Canada. Many new airports appeared almost overnight to provide the basic ground services, including weather information, for these new air-routes.

If upper-air observations in the north had previously been desirable as an aid to forecasting in southern Canada, they were now vital to flying within the arctic area itself. The Meteorological Division's first regularly reporting radiosonde station had been established in September 1941 at Gander, Nfld. During 1942, Fort Nelson, B.C.; Aklavik, N.W.T.; Prince Albert, Sask.; and Moosonee, Ont.; were added to the network. Radiosonde reports from these stations were supplemented by pilot-balloon observations of upper winds from several northern stations.

By way of assistance to the Canadian Department of Transport and to the Allied war effort in general, the United States provided radiosonde equipment and personnel for new upper-air stations at Arctic Bay, Frobisher Bay, Clyde River, Padloping Island, Fort Smith, Norman Wells, Churchill, Whitehorse, Fort Chimo, Coral Harbour and Southampton Island in the arctic area, and at Edmonton, Prince George and Grande Prairie farther south. In addition, the U.S. government supplied radiosondes for two Canadian-operated stations, Nitchequon and Port Harrison, both established in 1943. Some of these stations were also provided with radio equipment for determining upper winds.

Post-war Programme

Of the U.S. weather stations set up in northern Canada during this period, Arctic Bay, Fort Smith, Norman Wells, Prince George, Churchill, Coral Harbour and Whitehorse were taken over by the Department of Transport either before the close of the war or just after it. Others were

**WEATHER REPORTING STATIONS IN ARCTIC AND SUBARCTIC CANADA,
AS AT JANUARY 1, 1948.**

NAME OF STATION	Latitude ° N.	Longitude ° W.	Altitude ft.	Types of Observations	Year 1st surface observations made.
Aishihik, Y.T.	61 35	137 18	3170	S(H)	1943
Aklavik, N.W.T.	68 14	134 50	25	SI PR	1926
Arctic Bay, Baffin I.	73 16	84 17	15	S PR	1937
Baker Lake, N.W.T.	64 18	96 05	30	SI r)	1946
Cambridge Bay, Victoria I.	69 05	105 00	.....	SI a) b)	1928
Chesterfield, N.W.T.	63 20	90 43	13	SI P	1921
Churchill, Man.	58 45	94 07	115	SH PR b)	1884
Clyde River, Baffin I.	70 25	68 17	10	SH PR a)	1942
Coppermine, N.W.T.	67 49	115 10	13	SR R	1930
Coral Harbour, Southampton I.	64 11	83 21	193	SI PR	1933
Dawson, Y.T.	64 04	139 29	1062	S (I)	1898
Eureka Sound, Ellesmere I.	79 59	85 56	8	S PR	1947
Fort Chimo, Que.	58 06	68 25	50	SH PR b)	1921
Fort Good Hope, N.W.T.	66 15	128 38	251	S (H)	1897
Fort Nelson, B.C.	58 50	122 40	1230	SH PR	1934
Fort Norman, N.W.T.	64 54	125 30	30	S	1908
Fort Resolution, N.W.T.	61 07	113 37	519	S (H) b)	1914
Fort Ross, N.W.T.	72 02	94 03	50	(S)	1937
Fort Simpson, N.W.T.	61 52	121 21	415	S (H) P	1897
Fort Smith, N.W.T.	60 01	120 00	665	S (H) PR	1913
Frances Lake, Y.T.	61 17	129 24	2425	(S) (H)	1941
Frobisher Bay, Baffin I.	63 44	68 22	76	SH PR	1942
Hay River, N.W.T.	60 51	115 46	529	S (H)	1893
Holman Island, N.W.T.	70 30	117 38	30	(S)	1940
Cape Hopes Advance, Que.	61 05	69 33	240	SI b)	1928
Mayo, Y.T.	63 35	135 51	1625	d)	1927
Norman Wells, N.W.T.	65 17	126 47	290	SI PR	1944
Nottingham Island, N.W.T.	63 07	77 56	54	SI	1928
Padloping Island, N.W.T.	67 06	62 22	130	S (H) Pr)	1941
Port Harrison, Que.	58 25	78 08	66	SI PR	1921
Port Radium, N.W.T.	66 05	118 02	600	SI	1942
Providence, N.W.T.	61 20	117 40	529	S (H)	1942
Resolute Bay, Cornwallis I.	74 41	94 05	.....	S (I) PR	1947
Resolution Island, N.W.T.	61 18	64 53	127	SI	1928
Smith River, B.C.	59 30	126 30	2208	SH	1944
Snag, Y.T.	62 22	140 22	1925	SH	1943
Teslin, Y.T.	60 08	132 40	2300	SH	1943
Watson Lake, Y.T.	60 08	128 47	2248	SH P	1937
Whitehorse, Y.T.	60 42	135 07	2289	SH PR b)	1904
Wrigley, N.W.T.	63 13	123 26	511	d)	1943
Yellowknife, N.W.T.	62 28	114 20	656	S (H) P	1941

SYMBOLS:

- a) Position approximate
- b) Broken record
- d) Observations temporarily discontinued
- r) Radiosonde observations to be commenced in near future
- P Pilot balloon or radio wind observations.
- R Radiosonde observations.

Surface observations are made and transmitted as follows:

- S at the principal synoptic hours (0030, 0630, 1230, 1830 G.M.T.)
- (S) at some but not all of the principal synoptic hours.
- I at the intermediate synoptic hours (0130, 0930, 1530, 2130 G.M.T.)
- (I) at some but not all of the intermediate synoptic hours.
- H hourly throughout the 24 hours.
- (H) hourly during part of the 24 hours, or on request.

closed when the particular air routes they served were abandoned. Fort Chimo, Frobisher Bay and Clyde River are still operated by the United States.

During 1947, expeditions undertaken by joint participation of the Canadian and U.S. governments established stations equipped for surface, upper wind and radiosonde observations at Eureka Sound on Ellesmere Island and Resolute Bay on Cornwallis Island. The latter station, originally proposed for Winter Harbour, Melville Island, was established at Resolute Bay when heavy ice prevented the expedition from penetrating farther west. In the Northwest, the Department of Transport has recently set up a radiosonde station at Coppermine and will open another at Baker Lake this year.

The table on page 41 lists the names, positions and altitudes of the weather stations which were reporting regularly on January 1, 1948, within the arctic and subarctic areas (two stations which have been closed temporarily are included). In the case of stations where separate sets of observations are currently being made at an airport and at another site, the coordinates given are those of the airport. The second last column lists the types of observations currently being made. The dates given in the last column are the year in which the first surface observations were made, or, in the case of some of the earlier observations, the first year in which a complete set was made. When observations have been made at different sites in the same vicinity, the date given refers to the first observations made.

Reliability of Arctic Meteorological Data

It may be said that meteorological observations have kept pace with geographical exploration. However, there remain large gaps in the coverage of weather reports in the Arctic. Whereas the Mackenzie Valley and the Eastern Archipelago are well represented, there is a sparsity of stations in the central area of the Northwest Territories and in the Western Archipelago to the immediate north, an area of approximately a half million square miles.

It must be noted in assessing the value of meteorological data of the Arctic that the periods of observations were of different lengths at different stations and therefore should not receive equal weight. Further, as already noted, there is an uneven concentration of stations in the Arctic. Moreover, not all observations—especially in the early days—were taken simultaneously.

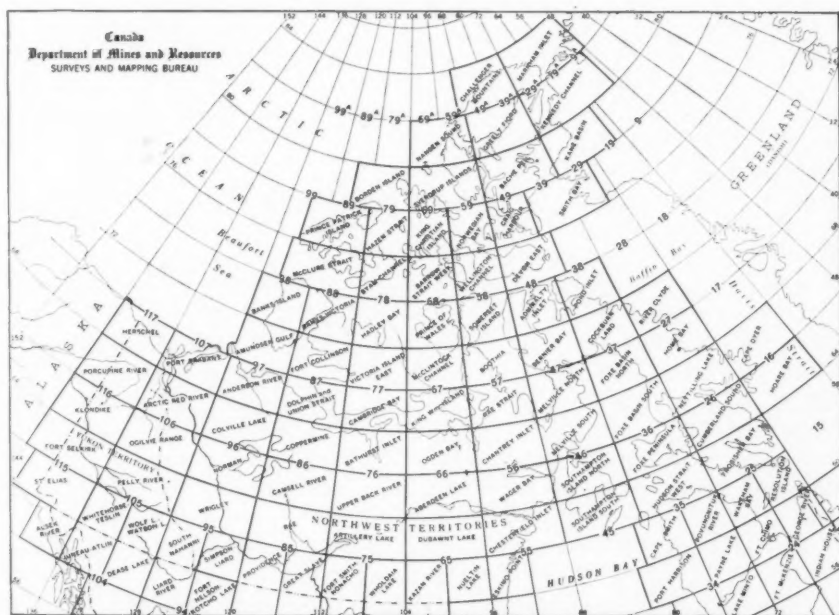
Observations of humidity have been for the most part made by means of dry and wet thermometers. During the winter months the observations by this means, especially in the far north, have been very untrustworthy.

Difficulty of transport of mercurial barometers, as well as the lack of communications for long periods, rendered the establishment of satisfactory pressure stations, especially in the early days, almost impossible. Errors were not known until data were received many months after observations. Changes

of personnel, observations made by poorly instructed men or substitutes, the long delay before the breakage of instruments could be remedied, the practical impossibility of inspection of the staff by Head Office—all these difficulties have been overcome, but have adversely affected pressure observations in the hinterland in the past.

The maintenance of an arctic network of meteorological stations is exacting and expensive. Nevertheless, it must be not only continued but expanded. The consensus of meteorological opinion the world over holds that in the arctic data lies the clue to both more accurate short-range forecasts and to the development of long-range forecasting techniques. To this must be added a recent requirement for meteorological services to new trans-arctic air-routes. The responsibilities of Canada in this connection are definite and unavoidable—it may be safely said that her meteorological eyes are and will be turned to the Arctic for several years to come.

MAPS OF NORTHERN CANADA



INDEX TO THE EIGHT MILE MAPS COVERING THE ARCTIC REGIONS

The above index shows those eight mile sheets of the National Topographic Series which cover northern Canada. All are drawn to the same scale on the Transverse Mercator Projection with each sheet fitting its neighbour. Owing to the lack of known ground elevations, most of the sheets are not contoured, and are at present printed in only two colours, black and water blue. As the necessary information regarding ground relief is obtained the proper hypsometric tints to indicate changes in ground elevation will be added. These maps may be obtained from the Surveys and Mapping Bureau, Department of Mines and Resources, Labelle Bldg., Ottawa, for 25 cents per sheet. It is hoped to publish corresponding diagrams of Greenland and Alaska in subsequent issues of *Arctic*.

ENCYCLOPEDIA ARCTICA

By VILHJALMUR STEFANSSON

Encyclopedia Arctica is to be like *Britannica*, but instead of taking in the whole globe our work is to focus on the Arctic and shade off into the Subarctic.

For EA purposes, the Arctic has not as yet been defined (as of 1948). The Subarctic on land has been considered provisionally as the region north of a line connecting the most southerly points at which permafrost has been discovered, whether in the Old or New World. According to Soviet writers of 1947, this would place within the sphere of EA about 47% of all their territories, mainland and islands; by estimates of various Canadian geologists and geographers, the sphere of EA would cover anything between 50% and 70% of their country's land surface.

It has not yet been decided for EA whether Newfoundland, Iceland, and Sakhalin are to be appended to the Subarctic, nor has the decision been made for the Kuriles. Arbitrarily it has been settled that all of political Alaska will be included, though some of the Aleutian Islands are as far south as Edmonton or Liverpool and although many components of that island chain seldom or never get colder, near sea level, than the minimum records of the State of Florida. At sea the outermost fringe of the Subarctic will be, in any longitude, the southern limit of drift sea ice or of icebergs, whichever is more southerly.

Scope of the Encyclopedia

EA is to have not less than five million and not more than six million words. Its goal, which we do not expect to approach closely, is to answer every question that any intelligent and reasonable person may want to ask concerning the region geographically covered. This means that the range will be from geophysics to Eskimo music and from the northern lights to Christian missions. We cover everything, whether imaginary or prehensible, from the vicinity of 49° N. Lat. on the northern shore of Lake Superior, where permafrost was uncovered during the building of the Canadian Pacific Railway around 1880, to 90° N. Lat. which Peary first attained in 1909. There will have to be some account both of how the permafrost was discovered and of how the North Pole was discovered.

EA considers the manner in which Canada, Denmark, the U.S. and the U.S.S.R. govern their Arctic territories; and, if by 1950 Newfoundland is not yet a part of Canada, we shall have to deal likewise with their management of Labrador. Nor do legal considerations cease at the world's most northern land, the north tip of Greenland; so there will be a discussion of international law (which perhaps should be in quotation marks as "international law") in its relation to the Arctic Sea, and there will be a more general paper on the Arctic in world politics.

To indicate further the scope of the encyclopedia we mention that there will be an article on the influence of polar exploration on the writings of Shakespeare, dealing also with his influence upon the geographical thinking of Elizabethan and succeeding generations. There will be a study of "what did they know and believe about the Arctic," with relation to the Egyptians, the ancient eastern peoples, the biblical Jews, the Phoenicians, the Hindus, Chinese, Greeks, Romans, Saracens and other remote nations, as well as those that were closer to the Arctic,

such as the Germans, Scandinavians, Russians, Netherlands and English. These papers will consider the garbled form in which the earliest discernible reports or theories about the Far North took shape, and will continue the story down to the present, or down to such time as one field merges into another, as in the case of the Greek epoch merging into the Roman.

It goes without saying that an encyclopedia which deals with the spiritual and the ethereal, like religion and music, will deal no less and even more with the strictly practical and the up-to-the-minute. We discuss not merely how primitive man reached Alaska across Bering Straits tens of thousands of years ago, and his migrations covering thousands of years, but also how the modern scientist has his breakfast conventionally in Fairbanks, lunches with a thermos bottle over the North Pole, and dines in Fairbanks, Alaska, or in London, England, that evening, where he discusses the results of his trip. We tell how the Eskimo makes skin boats, and how the engineer builds an air field. We deal with what the shaman tells us regarding spirit control of disease, and with what the physiologist tells us he has learnt at the Point Barrow research laboratories. In short, we aim to cover not merely all sciences but also all other branches of knowledge as they apply to the North.

Authors from Many Countries

According to the program, about half the encyclopedia will be written by ten research and clerical workers who are on the staff of the Stefansson Library in New York. Between 5% and 10% will be done by able piece-work writers who are not on salary because they work in spare time at various United States and Canadian libraries. About 40% will be done by distinguished specialists in a dozen or more countries.

In all cases the specialists selected to write the 40% are near the top in their field, but some of our contributors are as yet too young to be quite as famous as a few older men who do not contribute. For in rare cases we have to pass over the greatest of the living authorities through the circumstance, unfortunate for EA, that they do not write in English, and that we do not have the means for perfect translation—if indeed a perfect translation is ever possible.

In a number of cases contributors to EA are unique. For instance, William Thalbitzer of the University of Copenhagen writes on Eskimo music and on Eskimo phonetics, subjects which have been his life work; Morten Porsild, the supreme Greenland botanist, writes on the botany of Greenland; our Peary biographer, William H. Hobbs of the University of Michigan, has been a lifelong student, friend and collaborator of Peary and is the author of far the best of the published works on Peary; Harald Sverdrup, our writer on Polar Sea oceanography, is just resigning his professorship of oceanography at the University of California and his directorship of the Scripps Oceanographical Institution, to become head in Norway of institutions both national and international, that deal with polar studies. Rockwell Kent, our contributor on the scenic qualities of arctic lands, is foremost of all artists who have ever spent whole years at a time in the Arctic.

A main task of the EA editors is to discover in every land scholars who have already devoted to certain northern specialties anything from a few years to

several decades. Such men are the only ones whom we could expect as contributors, for the financial rewards held out to encyclopedia writers are small and standardized. The men who collaborate on EA do it for the good of the cause and, in some cases, because this gives them their first, or at any rate their best, opportunity of publishing to a considerable and significant audience the results of their scholarship.

Contributions from Learned Societies

A feature of the encyclopedia is that, generally speaking, learned societies and government departments will each write for it their own history, insofar as it relates to the Arctic. In this regard, the editors have come no croppers. Every scientific society, to whom we have appealed, has agreed; a third or more of them has already sent in manuscripts which run from 10,000 words down, some of them masterpieces and all of them good, for the societies have been careful to select writers who are no less articulate than they are well informed. From government departments EA has received corresponding promise of support, in some cases at the first application. In a few cases we have received preliminary drafts, but there are as yet no final drafts of government contributions. A meaningful reason for this delay is that arctic and subarctic work, particularly in the cases of the United States and Canada, is more active in 1948 than it ever was before.

Encyclopedia Arctica will be published by a regular commercial publisher, or rather by several. Tentatively the assumption is that the chief publisher will be a United States firm, with subsidiary publishers at least in Great Britain and Canada, perhaps in other countries.

All authors are being requested to supply for illustration as many photographs, drawings and diagrams as they can. No doubt there will eventually be a struggle between the editors and the publishers on how many of these can be included and on how sumptuous the presentation ought to be. For example, the use of expensive color plates has not been decided upon; there is a commercial argument for it, since the pictures of artists like Rockwell Kent, who is doing the papers on Greenland and Alaska scenery, will add considerably to sales volume.

Government Support Obtained

In spite of sales possibilities, it is obvious that a work like the *Encyclopedia Arctica* could not be compiled and published on a strictly commercial basis, the publisher being then expected to advance all money required not merely for the manufacture and sales promotion but also for the writing and editorial work. So the editors of EA necessarily had to seek patronage from a wealthy man, from a foundation or from a government agency. We sought and found government support. Like many another current scientific enterprise which does not fall either into the money-making or the "defense" class, our study is being financed by the Office of Naval Research, a branch of the Federal Government of the United States. The work began on December 1, 1946; the manuscript is to be ready for a publisher by December 31, 1949.

NORTHERN REVIEWS

GRÖNLAND 1945.

By OLE VINDINGS 148 pp; Gyldendal, Copenhagen, 1946. Kr. 6.85.

Books on Greenland which do not indulge in one or another fairy story of the idyllic life of the Greenlanders are rare, especially when they are written, as this book was, on a short acquaintance with the country. There are no fairy stories in Vinding's book. "*Grönland 1945*" is also remarkable for its display of knowledge of the country gained in only two summer seasons. The author expresses his indebtedness to the many Greenlanders and Danes from whom, by expert cross-questioning, much of the information was obtained. There is ample evidence, moreover, of considerable historical research.

Successful Wartime Administration

The general tone is critical of the administration and of the record of the development of Greenland. In this, the author is giving voice to a growing feeling of criticism among both Danes and Greenlanders, which grew to considerable pressure during the last war. The "invisible government" in Copenhagen, the government from a distance, the "policy of delay", the "fanatical conservatism" of the administration, and an out-dated constitution, are all aired, with a rare frankness, in the well-documented first chapter. The wartime administration, which was centred in Godthaab, and was thus the first administration to operate from within the country, is described as "a new wind over Greenland" and comes in for some well deserved praise. It is pointed out that had the wartime administration failed, the results might have been disastrous for Danish sovereignty.

The second chapter describes a conversation with two Greenland cousins who bear the same name—Nicolaj Rosing—one an outpost manager and member of the Greenland Assembly ("Parliament" or "Landsraad"), the other a school-master. Both these men are looking for better education and technical training for the Greenlanders, so that they may in fact be the equals of the Danes in Greenland. A magazine article written by one of the cousins is reprinted *in extenso*, the article favouring modification of the closed-shore and trade-monopoly policies to the extent of allowing the entry into Greenland, for trading and fishing purposes, of Danish nationals. The chapter ends by interpreting the anti-thesis between conservatism and progress in Greenland as a battle to free the Greenlander from his own inferiority complex, a complex which, according to the author, is a product of administrative policies in the early period (18th century).

Character of Greenlanders

Some sixteen pages are devoted to a discussion of the Greenlanders' feeling of inferiority, and its causes. The trouble is referred to as far back as the days of modern Greenland's first missionary, Hans Egede, when the Greenlanders' traditional social structure was broken down and inadequately replaced by Christian dogma. This, followed later by a paternal and protective administration which shielded the Greenlanders from their own faults, produced a population with no sense of responsibility, little native initiative, and an abiding conviction of its own helplessness. The argument is convincingly put, and implied in it is the interesting and important point that, within certain limits, the farther the

individual is advanced towards the European economy and method of thought, the greater the feeling of inferiority. The final threshold to a feeling of real equality, which requires the greatest effort, has seldom been crossed.

The problem of Greenlandic women is rightly given a section to itself. It has been emphasized many times during the history of Greenland, and especially in recent years, that the women are the key to the development and progress of the country. If they were properly educated, they could support and maintain by domestic influence progressive administrative policies. As they are, uninformed, conservative, and the complete mistress of the home, they can and do destroy most of the good done in the schools and hospitals.

Everyday Greenland

The fourth chapter "Everyday Greenland" covers various phases of Greenland life, including housing, health, the church, schools, industries and law. This chapter takes up over one third of the book, and contains much of the contemporary criticism to be heard in Greenland. The tuberculosis problem is treated superficially, but perhaps as fully as can be done in a work designed for the popular market. The section on the schools and the church (properly treated together) is excellent and manages to get to the heart of the problem in remarkably few pages. The recommendation of the 1945 meeting of the National Assembly, for more schools and the use of Danish as the language of instruction, is given proper emphasis, and the inadequacies of the ecclesiastical education, not only for general purposes but even for those going into the church, are brought out. The destructive influence of the home is not forgotten, but perhaps the author underestimates the difficulties of teaching the Eskimo mind along European lines.

The sheep farming developments in the Julianehaab, Frederikshaab and Godthaab districts are little more than alluded to. Considering the great promise which sheep farming has for the future, this is unfortunate. The fishery, although described in a ten-page section, is not treated as fully as one would wish, for it is Greenland's most important native industry. As Vinding himself puts it "the sea is Greenland's destiny". The key to the whole development, the recent hydrographic change in west Greenland, is nowhere mentioned, nor is the status of the seal population of Greenland given more than passing attention. The weaknesses of the present organization of the cod-fishery (shortage of salting-stations, sometimes shortage of salt, and so on) are well defined, but no allowance is made for what must lie behind the caution with which the fishery has been developed, namely the fear that the presence of cod in such numbers may well be only temporary. There is a good point, however, in the statement that the fishery can never be adequately organized by a government in Copenhagen—it must have an administration within Greenland.

This long fourth chapter concludes with a sympathetic account of the special problems of the administration of the law among Greenlanders, and a section on the training, which is considered inadequate, given to the Danish apprentices in the trade and administration, the young men who will later become colony managers.

The Future

There is much good stuff at the end of the book: an "introduction to the future", a description of the Greenlandic magazines and cultural life, and an account of the functioning of the "world's smallest parliament". There is a brief estimate of the mental development of the Greenlanders during the war, when Greenland had its own administration within its own coasts; the political awakening resulting in some most constructive proposals in the Landsraad Assembly on the future of the country; and the significance of recent articles in the Greenland press. There was an anxiety at the end of the war, a fear that the progress accomplished during the war would be nullified by unsympathetic action from Copenhagen. The Greenlander had had a peep out into the world and did not wish the window closed again, and he had come to realize the value of responsible government of the country *in* the country. Vinding concludes that changes in the constitution of Greenland are demanded by present developments, the most important being the establishment of the administration in Greenland instead of in Denmark.

He does not, however, favour opening the country up to private traders, fishermen or sheep-farmers, on the grounds that there is little enough in Greenland for the Greenlanders themselves. Finally, he puts the responsibility for the proper development of Greenland squarely upon the shoulders of the Danish voter and citizen, pointing out that the decision rests with him, and not with a "many-headed civil service". His closing sentence is: "in a free and democratic land there must be no doubt as to who is the master, who the servant".

Development of Greenland Remarkable

"Grönland 1945" criticizes or praises (rarely) the Danish administration of Greenland for the benefit of the Danish people. From the outsider's point of view it should be remembered that whatever criticism is levelled, the development of Greenland is still a remarkable story, perhaps unique in the history of colonial administration. Ole Vinding has written a book of great value at this point in Greenland's history, and one which demands translation into English. The translation, however, would have to be very skilled to match the quality of the Danish original. The author is a writer by profession, and the son of a writer; the tradition of letters is apparent in the work under review.

M.J.D.

RECONNAISSANCE GEOLOGY OF PORTIONS OF VICTORIA ISLAND AND ADJACENT REGIONS OF ARCTIC CANADA.

By A. L. WASHBURN, xi and 133 pp: 32 plates, maps, index. Geological Society of America, 1947.

On October 20, 1947, the Geological Society of America issued a memoir, number 22, entitled "*Reconnaissance Geology of Portions of Victoria Island and Adjacent Regions Arctic Canada*" by A. L. Washburn of the Arctic Institute of North America, Montreal and New York. The memoir is the result of investigations carried out during July and August 1938 and 1939 and from April 1940 to February 1941 by the author and in addition summarizes what information was available from other field studies such as those of Bernier, Douglas, and O'Neill.

In addition to the work on Victoria Island itself, Mr. Washburn made visits to a number of adjacent islands and to parts of the mainland coast.

Victoria Island is the second largest in the Canadian Arctic Archipelago having an area of 79,269 square miles. Much of it is low lying but parts rise over 2,000 feet. The oldest rocks of the region are Precambrian gneisses and granite but none of them are present on Victoria Island. Late Precambrian sediments and volcanic rocks do occur, however, covering large areas. In the general region under discussion Palaeozoic strata ranging in age from Ordovician to probable Permian are to be found. On Victoria Island fossiliferous Ordovician beds are known to be present and possibly Silurian rocks also occur. Strata which may be post-Silurian outcrop along the northwest coast. On Banks and Melville Islands and on the mainland coast Tertiary beds have been found. Though little information concerning the economic geology of Victoria Island and adjacent regions is available, it would appear that none of the known mineral occurrences are of any great economic importance at the present time. They are, however, possibilities for copper and coal.

Probably all of Victoria Island and most at least of the whole area under discussion was glaciated during the Pleistocene. Evidence includes smoothed and striated surfaces, eskers, ground moraines and other glacial deposits. The striae indicate more than one centre of dispersal. On Victoria Island there is evidence that the last movement was from a centre on the island itself.

Well-preserved strand lines show that Victoria Island has recently emerged to a vertical height of at least 500 feet. Marine fossiliferous deposits of mud and sand at various places tell the same story of recent uplift. No tilting of the emerged beaches was recognized. The emergence appears to have been essentially continuous below an altitude of 375 feet and probably below 510 feet although minor pauses occurred at subequal periods of time at least above 120 feet. There is evidence that the emergence was rapid, probably about 50 to 80 inches per century. The emergence is evidently related to deglaciation and was in progress during the closing stages of glaciation.

A considerable portion of the memoir is taken up with consideration of the geomorphic processes which have been responsible for the surface features. Ice rafting is regarded as having been of considerable importance. An excellent discussion of solifluxion and a description of the stone-circles, stone-polygons, mud-polygons, stone-strips, etc., grouped under the term *strukturboden* is given.

In an appendix are collected the striae observations collected in the Canadian Arctic. A most useful list of references is also given. Thirty-two excellent plates add to the attractiveness and usefulness of the volume. The memoir is accompanied by an index map of the Northwest Territories, a geological map on a scale of approximately 32 miles to an inch and a glacial map on a scale of 40 miles to an inch showing the emerged marine features and the striae directions in the Canadian Arctic.

The volume is attractively bound in cloth and will be a most valuable addition to the library of everyone who is interested in the Arctic.

F.J.A.

OUTLINES OF GEOGRAPHY, LIFE AND CUSTOMS OF NEWFOUNDLAND LABRADOR.

By V. TANNER with 342 photographs, cartograms and diagrams. Societas Geographica Fenniae, Acta Geographica 8. OY. Tilgmann A.B., Helsinki, 1944. Also Macmillan Co. (Can.) Cambridge University Press; two vols. 1947. \$12.50.

This book by Professor Tanner is based on observations made on the Finland-Labrador Expedition of 1937 and the Tanner-Labrador Expedition of 1939 and available literature and maps.

The book is divided into six parts dealing with the land, the sea, the climate, plant life, animal life and the races of men who have, or are inhabiting the coast.

Under Part I, Professor Tanner gives a very clear description of the physiography and geological structure of Labrador. This is followed by a detailed description of the Precambrian, and Palaeozoic rocks which form the mainland. He was assisted in this part of his report by Dr. E. H. Kranck, the author of a bulletin published by the Geological Survey of Newfoundland.

It is probably in connexion with the development of the peneplain, the rivers draining the plateau, the glaciation and the post glacial uplift, that Professor Tanner has made the greatest contribution in this section of his book. His treatment of these subjects can be said to be masterly.

Part II, dealing with the Labrador sea and current is an excellent summary of observations that have been made on the direction of flow, the temperature, the salinity, the tides, and the amount of ice. The inference to be drawn from this section is really, how little is actually known of the oceanography of this part of the Atlantic Ocean.

Climate is treated in section III. On p. 323 Professor Tanner states, "The air of the Labrador is so limpid that the summits of the mountains and the inequalities in their surfaces stand out against the clear sky with wonderful distinctness. In winter the atmosphere is extremely diaphanous all over the country, but also in summer the radiance and light along the coast are so brilliant at times that no artist could do them justice." Perhaps in this quotation Professor Tanner expressed what appeals to so many as one phase of the lure of the Labrador.

Under plant life Professor Tanner points out that the Labrador Peninsula is one of "the most southerly of the countries including a connected Arctic vegetation." He speaks of the tundra, the forested areas and the bogs. Part V, the animal life is given very briefly in 19 pages. The rest of the book from pp. 437-831 is taken up with the races of men, their ethnology and human geography.

In the opinion of the reviewer one or two statements are in error. On page 98, in the photograph taken from *Northernmost Labrador, Mapped from the Air*. American Geographical Society, Publication 22, N.Y. 1938, a synclinal fold is shown on the north shore of Saglek Bay and it is stated to be of "the folded Ramah beds upon upbended gneisses". The reviewer has examined the rocks of this syncline and found that they do not belong to the Ramah Series.

In conclusion, we are all deeply indebted to Professor Tanner for this great work which included not only two field studies but the gathering of 1,127 published references and an extensive cartography.

G.V.D.

THE NEW NORTH-WEST.

Edited by C. A. Dawson. Toronto: University of Toronto Press—Saunders, 1947. 341 pp.; illustrations and maps. \$4.25.

In 1944, the Canadian Social Science Research Council, with the financial support of the Rockefeller Foundation, organized a series of studies of northern Canada to stimulate public interest in the development of the region and to provide a background for more extensive investigation. The results of some of these studies have been published in the *Canadian Journal of Economics and Political Science*. In *The New North-West*, this series of articles and others dealing with north-western Canada have been brought together in one volume.

The book contains twelve parts, all except two by different authors. They discuss respectively: administration, Mackenzie and Yukon domesdays (two parts describing in detail the geographical setting and plan of settlements in these areas), mineral industry, fur production, northern agriculture, transportation, health conditions and services, education, the Eskimos and the new north-west. The last section is a bibliography which covers the whole of northern Canada and lists about four hundred selected titles in alphabetical order. It will be of more interest to the general reader than to the advanced student. The remainder of the book deals only with the western northland, chiefly within the limit of trees.

The penultimate section discusses such developments as the Yellowknife gold mines, Norman Wells oil, and the Alaska Highway. In the light of even more recent developments, a more apt title for the book would have been *The Changing North*.

The sections on health and education contain valuable criticism and suggestions. They should be read with great care not only by those responsible for the administration, but by every educated Canadian. The Yukon and Mackenzie domesdays will be of interest to those familiar with the settlements, and of value to future historians. The sections on agriculture and the mineral industry give a balanced judgment of the possibilities of the region which are shown to depend on adequate transport facilities. The fluctuations in the cycles of fur bearers are well illustrated by graphs. It is unfortunate that more exact and detailed information is not given on the western Eskimos.

Neither the paper nor the photographs, of which there are forty, do justice to the text. Four of the photographs have previously been published in *The Beaver* (Dec. 1943) with an article on Norway House, at which post they were presumably taken. Another photograph of a trading post in James Bay is equally irrelevant.

This book is informative, but not too technical for the layman. It is to be hoped that it will receive the wide circulation and thorough study it deserves.

T.H.M.

GREENLAND AT THE CROSSROADS

By ERLING PORSILD

AGAINST the background of events in colonial and mandated areas throughout the world it is interesting to observe current trends of development and thought in the large, but thinly populated Danish arctic Colony, Greenland where Danes for 227 years with little or no outside interference have guided and administered the affairs of a 'once aboriginal and primitive race of people. Comments on recent developments in Greenland have been lucidly presented in a series of talks given at two meetings held in 1947 by the Danish-Greenland Society (*Det Grønlandske Selskab*) of Copenhagen, as printed in the Society's Yearbook (*Det Grønlandske Selskabs Aarsskrift*, 1947).

The Greenland Society was founded in Copenhagen, in 1906, and is a non-political organization which aims to foster and promote interest in Greenland, to maintain and establish social and cultural relations between Greenland and Denmark, and to provide a forum where matters related to the welfare and development of the island and its people may be voiced. The present membership is 931 and consists largely of Danes and Greenlanders who, as Government administrators, topographers and explorers, scientists, educators, civil engineers, and artists, or merely as past visitors, are actively interested in Greenland, or who have lived or worked in the island. Meetings are held in Copenhagen during the winter, when lectures followed by discussions and by informal social functions are held. The lectures, together with other original articles dealing with the history, archaeology, folklore, sociology, physiography or natural history of Greenland, are published in the yearbook, together with reports on the society's activities. Besides the yearbook the society publishes book-length monographs on Greenland, in a series entitled *Det Grønlandske Selskabs Skrifter* of which, to date, 15 volumes have appeared.

Because the society is entirely non-political and because its membership is composed of outstanding specialists and authorities in many fields, important problems related to Greenland have frequently been brought into open discussion at meetings of the Greenland Society, and the Danish Government has often been responsive to and interested in the opinions expressed.

The 1947 yearbook of the Greenland Society is of unusual interest because it is almost entirely devoted to the reporting of a series of papers read during meetings held in December 1946 and January 1947, when the report of a Parliamentary Commission on Greenland published the previous June formed the topic of discussion.

Before analysing these reports, a summary of the history of the Danish administration of Greenland may be helpful.

For more than 200 years, or until Nazi occupation of Denmark, in April 1940, Denmark's last and only colony has been governed from Denmark by a paternalistic and benevolent, if also somewhat bureaucratic, Danish Government Department. If the Greenlanders themselves have had little or no influence on the policy by which their island has been administered, there can, at least, be no question that the motives dictating the Danish policy in Greenland during the last century, have been entirely altruistic. With its small population of 22,000 people of predominantly Eskimo blood, Greenland provides no important markets

for Danish exports. Although the largest island in the world, Greenland, is an arctic country, poor in natural resources, and far from being revenue-producing, its administration each year has led to a deficit which has been met by the Danish Government.

Denmark has always maintained a closed-door policy in Greenland, which permits of no trading or outside interference with the native population; not even Danish citizens are allowed to go to Greenland except in the service of the State or for specially authorized visits. Through monopolistic trading establishments in Greenland the Administration provides the Greenlanders with such trade goods as are considered needful and beneficial, in return for Greenland produce which largely consists of cryolite, seal and whale oil, salt fish and fur. The Administration also operates a shipping service, maintains free hospitals and medical services, schools and educational facilities, and even provides religious education through the Lutheran State Church.

In Greenland a small number of Danes in key positions, aided by a host of native clerks, shopkeepers, school teachers, clergymen, nurses and artisans, for over 200 years have carried out the autocratic policy of the Greenland Administration with a high degree of success which is reflected in the steady and rapid increase in the Greenland population and in the general standard of living which, by comparison with that of Denmark is low but, nevertheless, commensurate with the economic possibilities of a country extraordinarily poor in natural resources. It has been the purpose of the Danish policy to maintain Greenland for the Greenlanders and to protect them against exploitation by free traders as well as against possibly "unhealthy" or undesirable influences from the outside world. Also, to the Danes, Greenland for many years has been an arctic laboratory where Danish scientists and explorers have found a fruitful field. The results of their unselfish and important work, of which they are justly proud, is reflected in the unique scientific series *Meddelelser om Grønland* in which 145 large volumes have been published to date. Thanks to the work of Danish scientists, Greenland today is by far the most completely explored arctic land in the world.

Up to the first world war, which did not touch Greenland at all, the island's economy has been largely based on primitive Eskimo sealing and hunting, but during the last three decades, due to the diminishing numbers of seals, the sealing industry has declined and is gradually being replaced by cod fishing and sheep farming which, with cryolite mining, are the principal industries. In line with the conservative Danish policy the change-over has been deliberately slow. Time did not matter very much in Greenland where no one ever did things in a hurry, and where the Greenlanders lived a sheltered but happy and contented life. No one ever went hungry for long, nor did any one ever become very prosperous, for all trading and trafficking, all industry, as well as the price of labour and native produce, were controlled by the State. In this completely nationalized economy prices never changed. Completely sealed off from the outside world, the economy, so to speak, operated in a total vacuum. Visitors to Greenland found life in the island idyllic and carefree, a solace from the hectic, striving competition and foolish rush of other lands. But it has long been realized by most responsible Danes that some day Greenland would have to be opened; but

whenever the matter came up for discussion, it was easy to "prove" that the Greenlanders were not yet sufficiently advanced and the economy and resources of the country of such a nature to preclude introduction of free trade and enterprise.

During the same period the slowly awakening desire amongst the Greenlanders for political self expression was allowed to develop through the establishment of native village and county councils and of two provincial, advisory native assemblies (*Landsraad*), one in North Greenland and one in South Greenland. Whenever legislation was proposed by these native councils which, by the Greenland Administration was considered too precocious, the matter could always be referred back and forth between the two provincial assemblies who could seldom reach an unanimous decision.

This, then was the general situation in Greenland when the German occupation of Denmark, in April, 1940, rudely cast Greenland adrift from the motherland. Fortunately, the foresighted Danish Administration had provided fairly substantial stocks in Greenland of the most needed supplies, sufficient to tide the country over for the first difficult period until contacts could be established with Canada and with the United States. Likewise, constitutional powers had been vested in the local Greenland administration for the formation of an emergency Government which, under the wise and able direction of Governor Eske Brun, conducted the affairs of Greenland until the liberation of Denmark.

During the four years of Governor Brun's energetic one-man Government, unhampered by apron strings of the impotent Greenland Administration in Nazi-controlled Copenhagen, Greenland experienced a period of unparalleled prosperity and unheard of improvements, made possible by the unprecedented demands for Greenland cryolite, indispensable to the Canadian and American aluminium industries, and to the equally great demand for Greenland salt cod.

Greenland possessed no industries, no timber and no raw materials and produced no food other than meat and fish. But ample dollar credits from the exports of cryolite and salt cod made Greenland economically independent and provided adequate means for the chartering of ships to bring supplies of food, oil, clothing and materials to expand the fishing industry in addition to building materials indispensable to a country entirely lacking in forests.

During the four years of separation from Denmark the loyalty of the Greenlanders never wavered; but with the approaching re-union many Greenlanders began to wonder if they would be permitted to retain their many newly-won improvements, and particularly the simplification and unification of administration, or if the former Greenland Administration would wish to resume its unprogressive pre-war policy. The Greenlanders, therefore, entertained high hopes when, in 1946, the Danish Government appointed a Parliamentary Commission to which six representatives of the combined Greenland Councils were called. To aid this Commission was called, also, the head of the Greenland Administration in Copenhagen but, strangely enough, no representatives of Greenland's wartime Government. The Commission was to study and recommend changes in the administration of Greenland. Its report to the Danish Parliament which was published June 12, 1946, was disappointing to most

Greenlanders and Danes in Greenland alike. Criticisms were that the Commission had dealt almost entirely in generalities and with small and unimportant matters related to local administration and that it had deliberately chosen to ignore the important and very real changes which had taken place in Greenland during the four years of separation. It was felt, moreover, that the Commission had studiously avoided considering the demand for a shift from Copenhagen to Greenland of the executive offices of the Administration. Other matters to which it was felt that the Commission had not given sufficient thought were the urgent needs of the Greenland fishing industry where, in spite of many improvements introduced during the last few years, fishing methods were still antiquated and facilities for handling the increased production entirely inadequate to meet strong competition from foreign fishermen.

This was the report which was brought under discussion at the two meetings reported in the Greenland Society Yearbook of 1947. With strict impartiality the society had invited speakers representing the Danish Parliament, the head of the Greenland Administration in Copenhagen as well as the war-time Government of Greenland; also Greenland educationists, members of the Greenland clergy, representatives of native Greenlanders, and of science and health organizations. It is interesting to note that the opening speeches of both meetings were made by native Greenlanders who most ably expressed the views of their countrymen. It speaks very well for the 200 years of Danish administration of Greenland that the demands of the Greenlanders, as voiced by these men, included nothing more revolutionary than a strong demand to have the seat of the Greenland Administration removed from Copenhagen to Greenland where it should be directly responsible to a Danish Government Department. These men made no demands for independence for Greenland, nor even for Greenland representation to the Danish Parliament; but they did make a strongly voiced representation for the opening of Greenland to free Danish and Greenlandic enterprise and for the establishment in Greenland of a modern fishing industry, a better health service, better schools and, most significantly, demands for the introduction of the Danish language in the Greenland schools where, heretofore, the Greenland Eskimo dialect had been taught almost exclusively.

The most important contribution to the discussion of Greenland's future was made by Governor Brun, now Vice-Director in the Greenland Administration in Copenhagen who, in his address, realistically outlined the situation in post-war Greenland. His opening remarks aptly sum up the problems: "The year and a half that has elapsed since Greenland was again united with Denmark has, perhaps, been the most momentous in the modern history of Greenland because the relation between Greenland and Denmark now has to be scrutinized and carefully tested in the light of recent world developments; the course of the future must now be chartered along lines that will justify the confidence which the Greenlanders have placed in Denmark. One false step, or the omission of a necessary one, may have far-reaching consequences."

Governor Brun fully realizes that the time has come when realities rather than tradition must be the yardstick and that half-measures and compromises will no longer suffice; that in view of the needs for global transportation and

defence Denmark no longer can hope to maintain Greenland as a purely Dano-Greenlandic sphere of interest and that the days of a firmly closed-door policy with its corollary of state monopoly of trade and enterprise were irrevocably over when, during the war, American defence bases were established in Greenland; that the law of supply and demand must henceforth determine the price of labour and of cod fish and that means must be found whereby the Greenlanders may take a more active part in the development of their country.

Governor Brun does not say how he proposes to bring about these changes; that must be left to the Danish Parliament. But he points out that due to historical causes the Greenland economy in the past has been closely geared to traditional and primitive Eskimo economy based primarily on sealing and the life habit of seals, and that the present principal Greenland townsites were selected primarily from the point of view of natural harbours easily approachable by sailing vessels and with regard to the location of ancient Eskimo villages that were again selected with an eye to seal migration and not at all with regard to climate, water power, cod fishing or sheep farming.

Subsidiary to the present Greenland towns are a large number of trading posts and villages so that the present population of 22,000 Greenlanders today live in 175 widely scattered municipalities and settlements. This naturally creates great difficulties; transportation and distribution become inefficient and costly in requirements of manpower and ships because of the excessive handling and reshipping. The present scattered population makes proper health and educational facilities needlessly costly. Many of the small villages and towns will have to be abandoned as permanent settlements and trading posts, and the population centralized in fewer and larger towns. The Greenland fishery has developed, with slight modification, from the ancient Eskimo kayak sealing methods, and even today much fishing is done from one-man kayaks or from small rowboats. For the same reasons the shore installations, where codfish is cleaned, salted and packed for export are all located in the towns, and the fishermen are but rarely able to venture more than a few miles out to sea and thus cannot reach the best fishing grounds. Although the cod fisheries of Greenland are among the richest in the world, although climate and other conditions ideally suited, and labour cheap, Greenland today produces no more salt cod yearly than do a few of the sea-going foreign fishing schooners that in large numbers each summer fish off the Greenland shores which are closed to them.

Therefore, one of the most important problems in Greenland today is the centralization and relocation of population. In regard to the present economy few if any of the towns are well located. Naturally, it will not be possible to build twenty new towns in Greenland, complete with modern harbour installations, power plants, shops, sanitation facilities and so forth, but because most buildings and installations in present Greenland towns are hopelessly inadequate and antiquated now is the time when serious thought should be given to the relocation of a few key supply and administration centres where fully modern towns should be built.

ARCTIC INSTITUTE RESEARCH PROGRAM

The following research projects are being carried out with the aid of Arctic Institute grants-in-aid.

Botanical investigation along the Romaine and George Rivers, Ungava. Field work carried out during the summer of 1947 by Dr. Jacques Rousseau, Director of the Montreal Botanical Garden.

Botanical and forestry investigation along the east coast of Hudson Bay. Field work carried out during the summer of 1947 by Dr. Ilmari Hustich of the University of Helsinki, Finland, in cooperation with a party from the National Herbarium, National Museum of Canada, Ottawa.

Botanical investigation of the Canadian Eastern Arctic. Field work carried out during the summers of 1946 and 1947 by Dr. Nicholas Polunin of McGill University, Montreal. Dr. Polunin worked in cooperation with the Department of Mines and Resources, Ottawa, and the Royal Canadian Air Force.

Investigation of the breeding grounds and breeding habits of the Canada Goose in the James Bay area. Field work carried out during the summers of 1946 and 1947 by Harold Hanson of the Illinois State Natural History Survey, Urbana, Illinois.

Ethnological study of the Peel River Indians, Mackenzie Valley. Field work completed in the spring of 1947 by R. D. Slobodin of Columbia University, New York.

Ethnological study of the Eskimo of Nunivak Island, Alaska. Field work completed in 1946 by Dr. Margaret Lantis of Washington, D.C.

Projects supported by contractual arrangements between the Arctic Institute and United States Government, comprise the following:

Permafrost investigation involving recognition of permafrost conditions as revealed by aerial photographs and their correlation with ground conditions. Field work carried out during the summer of 1947 by Dr. D. J. Belcher, School of Civil Engineering, Cornell University, Ithaca, N.Y.

Geological research along the east coast of Hudson Bay. Field work carried out during the summer of 1947 by Dr. E. H. Kranck, University of Neuchatel, Switzerland, in cooperation with Dr. Hustich of the University of Helsinki, Finland, and the National Museum in Ottawa.

Biological Investigation of the Nueltin Lake area, west coast of Hudson Bay. Field work during 1947 by Dr. Francis Harper of Moylan, Pa.

Investigation of the relation of environment to heredity as revealed by a study of Colias in the Canadian Northwest. Field work initiated the summer of 1947 by Dr. William Hovanitz of the University of Michigan.

Investigation of the distribution of fur-bearing animals in the Canadian North-west. Field work being currently carried out at Fort Nelson, B.C., by Professor H. F. Quick, Fort Collins, Colorado.

Projects being carried out by contractual arrangements between the Arctic Institute and the Canadian Government:

Terrain study of the Ungava Peninsula. Dr. G. Vibert Douglas of Dalhousie University, Halifax, Nova Scotia.

Terrain study of the Canadian Eastern Arctic. Dr. T. T. Paterson of Trinity College, Cambridge, England.

Study of the oceanography of the Canadian Eastern Arctic. Dr. M. J. Dunbar of McGill University, Montreal.

The coasts of Hudson Bay and Hudson Strait. T. H. Manning, Ottawa.

Study of the mammal and bird population of Canada north of 60 N. Lat., and its value for survival. Dr. A. L. Rand of the Chicago Natural History Museum, Chicago, Illinois.

SCIENTIFIC NOTES FROM GREENLAND IN GRÖNLANDSPOSTEN

The best source of general information on Greenland between 1940 and 1945 is the journal *Grönlandsposten* which was published every two weeks in Godthaab, wartime capital of the country, under the editorship of Mag. Christian Vibe a biologist. Originally planned as an official gazette, the journal became a forum for the discussion of public questions. Scientific reports appeared occasionally, together with descriptions of Greenland occupations and industries. Late in 1945 the editorial office moved to Copenhagen where it remained until 1947 when it returned to Godthaab, with the appointment of a new editor.

As students of Greenland may not be aware of the useful, although brief, scientific reports which have appeared in *Grönlandsposten*, the following titles (translated from Danish) have been selected from the 1946 and 1947 volumes. A complete file of the journal has been placed in the library of the Arctic Institute in Montreal.

Volume V, 1946.

"On the trail of "mud volcanoes" in Northeast Greenland"

Prof. Alfred Rozenkrantz pp. 8 - 10

"A reconnaissance of Norse ruins and excavations of old Eskimo

houses in Godthaab District"—Eigil Knuth pp. 19 - 20

"Origin and growth of the Greenland fishing industry"—Chr. Vibe pp. 30 - 35

"Greenland underground" (A description of the work of summer

geological parties in Greenland in 1946) pp. 82 - 85

"The renewal of fisheries research in Greenland" pp. 92 - 94

"East Greenland today"—Captain Ejnar Mikkelsen pp. 186 - 147

"Magnetic notes from Godhavn"—Asger Lundbak pp. 230 - 233

"Fisheries research in 1946 with M/V *Adolf Jensen*"—Poul Hansen pp. 233 - 235

"Botany in Greenland"—Morten Lange pp. 237 - 239

"Geological research in Greenland during the 1946 summer" pp. 271 - 275

"Geological and geophysical research at Ivigtut" pp. 275

"The biology of walrus and seals in Thule District"—Chr. Vibe pp. 281 - 287

"A monastery in Unartoq Fjord"—C. L. Vebaek pp. 287 - 289

Vol. VI, 1947.

"Ornithology in 1946"—Finn Salomonsen pp. 14 - 16

"Zoological problems in Greenland"—Prof. R. Spärck pp. 22 - 23

"A Botanical expedition to Disko" (Study of chromosomes in

plants)—Prof. C. A. Jorgensen pp. 23 - 24

"Geodetic surveying in Greenland"—J. F. Chautelon pp. 35 - 39

"Research on climate changes in Greenland"—J. Troels Smith pp. 41 - 43

NORTHERN RESEARCH REPORTS

AEROBIOLOGY

Aerobiological Investigations in the Arctic and Subarctic

In view of the considerable development of the subject in civilized regions, and of its possible economic as well as academic significance, it is surprising how little work has been done in the North on the presence and identity of botanical and other 'particles' in the atmosphere. To be sure, it has long been known that fungal spores and other disseminules may be present in the air in boreal regions north of the limits of extensive cultivation—as for example over Norway House, Manitoba—but so far as the Arctic and Subarctic are concerned the undersigned know of only two attempts at aerobiological investigations prior to 1947. These were by one of us (N.P.) in Lapland and Spitsbergen in 1933, and by Lindbergh over Greenland etc. in the same year. The former work was abortive in that the "observations" were deemed insufficiently reliable for publication although they gave some suggestion of the presence of rather plentiful viable disseminules in the air at low altitudes; the latter work appeared to confirm these suggestions for higher altitudes but was unfortunately never described in any detail. It remained for one of us (N.P.), while flying with the Royal Canadian Air Force during August and September, 1947, on operations concerned primarily with ground survey work and locating the North Magnetic Pole, to expose from his aircraft nutrient Petri plates and vaselined microscopical slides especially prepared and packed under the direction of another of us (S.M.P.). Details of preparation, exposure, and packaging have already been published (*Nature*, vol. 160, pp. 876-7, 1947); a total of 51 plates and 52 slides were exposed, the former for two minutes each and the latter for five minutes each. Not a single contamination developed on any of the 7 unexposed plates that were brought back as controls, so that full confidence is felt in the apparatus and methods employed although these were quite simple.

Most of the 1947 exposures were made at or around an altitude of 5,000 feet and airspeed 100 knots (115 m.p.h.), well outside the fuselage of Norseman and Canso aircraft. Except for inevitable gaps due to liquid or ice precipitation or preoccupation with landing, etc., a nutrient plate and a sticky slide were exposed either every twenty or every thirty miles, approximately, throughout the flights concerned. The first of these flights was on August 12th, and extended in a northerly direction from a base-camp situated on an unnamed lake north-west of Great Bear Lake to Langton Bay on the Arctic Ocean coast, and thence to the mouth of the Horton River. The later exposures extended over about 1,500 miles from Somerset Island southwards to Edmonton, Alberta.

The vaselined slides have been sent to specialists to examine for the spores of pathogenic Fungi which do not culture. Already the Dominion Rust Research Laboratory, Winnipeg, have reported that on some of the slides exposed near the Arctic Ocean coast there are represented spores of three of the most important airborne pathogens of cereal crops of Canada, viz. Wheat Stem-rust (*Puccinia graminis tritici*), Wheat Leaf-rust (*P. rubigo-vera*=*P. triticina*), and Foot-rot of Barley and Rye (*Helminthosporium sativum*). This is the better part of 1000 miles north of the Peace River region, which is the nearest likely source of supply of any real extent, and would seem to extend remarkably the much-cited "at

least 200 miles" that spores of the first-named important parasite (which alone has caused an estimated loss in western Canada through injury to the Wheat crop of as much as \$200,000,000 in a single year) are known to have been disseminated. Subsequently the slides will be sent to pollen specialists who will determine their pollen-grain holding, which curiously enough may be of significance in connexion with investigations of 'muskegs.' Later, other specialists may be involved in various fields.

We ourselves are dealing in the first instance with the considerable range of Fungi and Bacteria that are represented on the plates. And whereas we had expected few or no colonies to develop on incubation of the plates that had been exposed in the Far North, for instance in northerly winds over the ice-fields of M'Clintock Channel, we find that almost all on return bore numerous and various colonies of Fungi and Bacteria, indicating both these groups to be abundantly and diversely represented in the arctic atmosphere. As examples we may note that one plate exposed at 4,500 feet near the east coast of Somerset Island around latitude $72^{\circ}40'N.$ and longitude $94^{\circ}W.$ showed a total of 12 colonies of Fungi and 79 of Bacteria, while another exposed at 4,400 feet over the sea-ice of M'Clintock Channel showed 7 colonies of Fungi and 95 of Bacteria. On the other hand, a plate exposed only 10 minutes earlier than the first-mentioned, and in the same general region, showed only 3 fungal and 47 bacterial colonies. A more detailed report will follow in due course.

It is our earnest hope to be able to continue and extend these investigations in various ways, particularly in the near future through winter and summer flights to the North Pole and by comparison of the spore content of the arctic air at different altitudes from the ground upwards. Such observations, when correlated with the clear meteorological conceptions and particularly more detailed upper-air movement data that will be forthcoming shortly, should tell us much about the origin, trajectory, and fate of these disseminules.

McGill University, Montreal.

NICHOLAS POLUNIN,
S. M. PADY,
C. D. KELLY.

BOTANY

Mackenzie Valley

A. E. Porsild, Chief Botanist, of the National Museum of Canada, Ottawa, accompanied by Ralph Bryenton of the Pas, Man., in July travelled down the Mackenzie River by canoe, where he paid particular attention to tree species and to problems of plant succession following the last 25 year's of forest fires. His collection of plants made along the Mackenzie includes a number of rare and interesting species previously known to extend only to Slave Lake.

After reaching the Delta, he spent a month in the Mackenzie Reindeer Grazing Reserve where he reported on the progress made in the reindeer experiment since 1936. Travelling by plane he examined the spring, summer, fall and winter reindeer pasture throughout the reserve, from the East Bound to the Anderson River.

Leaving Aklavik on August 19, he travelled by air via Edmonton to Fairbanks, Alaska, where, on August 29-30, he accompanied a reconnaissance flight

across the northern part of the Arctic Archipelago to Ellesmere Island and back. He returned to Ottawa on September 3rd.

James and Hudson Bays

A second National Museum field party spent the summer making a botanical survey of the east coast of James and Hudson Bay. In the party were W. K. W. Baldwin and James Kucyniak of the National Museum, the ecologist I. Hustich and the bryologist R. Tuomikoski, both of the University of Helsinki, Finland, and both travelling on an Arctic Institute of North America Research grant. With the party travelled the geologist Dr. E. H. Kranck of the University of Neuchatel, Switzerland. The party left Ottawa in late June travelling from Moosonee by schooner and canoes; they returned to Ottawa early in September.

James Kucyniak assisted in the technical work of collecting vascular plants and cooperated with Dr. Tuomikoski in collecting mosses and made special collections of lichens. W. K. W. Baldwin made a general collection of vascular plants sufficient for six duplicate sets. Rare and critical species were collected from as many different habitats and stations as practical. Ecological notes were made at each station and were supplemented by many photographs showing topography and vegetation types. Observations were also made of forage cover with particular emphasis on requirements for caribou and domesticated reindeer.

The main work of Dr. Tuomikoski was to investigate the flora of Bryophytae. No professional bryologist had earlier visited the region. The moss flora was not particularly rich, but about 265 species were collected, including one which seems to have been unknown to science. The material collected and registered gives a clear picture of the difference between the more arctic moss flora on the islands and the moss flora on the mainland, as well as between that on the mainland around James Bay and on the more rocky terrain around Hudson Bay. The moss flora consists of about ninety percent of circumpolar arctic and subarctic species. Only a more careful microscopical investigation can show whether it is possible to distinguish between American and European races of the same species.

I. Hustich studied the forest conditions in the region. Notes were made on the maritime tree limits on the coast and islands of James Bay and southern Hudson Bay, where the dominance of white spruce was noticed. Several weeks were spent at Great Whale River making forest type analyses and increment borings.

Ungava

Dr. Jacques Rousseau, Director of the Montreal Botanical Garden, spent the 1947 summer field season in Ungava, following the George River from its source near Lake Mishikaman for about 350 miles to the sea. Dr. Rousseau made a large herbarium collection and also was able to make notes on geology, native peoples, and animal life.

Dr. Rousseau hopes to be able to continue his study of Northern Quebec in 1948 with a journey from Payne Bay to the eastern shore of Hudson Bay.

ZOOLOGY

Nueltin Lake Expedition

Dr. Francis Harper spent from May 31 to December 4, 1947, in the area about the northwestern extremity of Nueltin Lake in southwestern Keewatin. This lake lies near the centre of one of the largest regions of western Canada not hitherto investigated by professional biologists. Scarcely any definite or authentic information had been available concerning the fauna and flora within a radius of some 200 miles in most directions.

The principal objectives of the expedition were investigations of the local fauna, flora, geography, and physiography. The 250-mile trip each way between Churchill and Nueltin Lake was accomplished by air. Early arrival and late departure made possible observation of the greater part of the annual migrations of the birds and the Barren Ground Caribou.

The season's collections included more than 100 mammals, more than 100 birds, several Wood Frogs, some dozens of fishes (apparently representing every species known to the Nueltin region), and varying numbers of worms, mollusks, crustaceans, insects, arachnids, plankton, and diatoms. Special attention was paid to ectoparasites of mammals and birds, and to both external and internal parasites of fishes. About 800-1,000 sheets of plants were collected representing flowering plants, ferns and their allies, mosses, fungi, and lichens. The photographic material consists of 1,000 feet of 16-mm. motion pictures in color, 120 35-mm. photographs in color, and about 325 4 x 5 inch negatives in black and white.

A large fund of information on the distribution, ecology, economics, habits, and general life histories of the local vertebrates was assembled. Several sketch maps, will supplement the inadequate maps, hitherto available. Perhaps the most interesting physiographic feature noticed was an ancient beach terrace evident at several different points about Windy Bay, at an elevation approximately 100 feet above Nueltin Lake.

Farley M. Mowat of the University of Toronto, accompanied Dr. Harper during the first month of the expedition. In June he travelled by dog-team along Windy River remaining for a month on a faunal survey and collecting invertebrates fish, birds and mammals. During July he travelled by canoe to Brochet by the Kasmere River, returning early in August. Following some time spent on topographical sketching on Nueltin Lake he descended the Thlewiazia River to Hudson Bay by canoe, and reached Eskimo Point at the end of August.

Forest Fur Animal and Ecology and Management

Professor H. F. Quick left Colorado late in August 1947, to spend the winter at Fort Nelson, B.C., to study the fur animals of the surrounding area of about 50,000 square miles. He is particularly interested in the species and numbers of prey animals and has also undertaken small mammal population studies in two widely separated parts of the region. Another purpose of the expedition is to make a study of the food habits of the wolverine, fisher and lynx. The assistance of trappers in the vicinity has been secured.

Marine Biological Reconnaissance in Ungava Bay, 1947

At the request of the Department of Mines and Resources, the Fisheries Research Board of Canada undertook a preliminary survey of the marine resources

of Ungava Bay during the summer of 1947, with the ultimate purpose of improving the diet and standard of living of the Ungava Eskimos. Serious malnutrition had been found among these natives. The work was planned and carried out by Dr. Max Dunbar, of McGill University, who with Mr. Henry Hildebrand, also of McGill, spent three months in the field. The party flew to Fort Chimo by special R.C.A.F. aircraft, with some 3,000 lbs. of equipment, in June. The coastal waters of Ungava Bay were covered from Payne Bay in the North-west to Port Burwell in the North-east. A comprehensive collection of benthos, plankton and fish was brought home, and the hydrographic work included observations of temperature, salinity and oxygen at all depths. The expedition made a first-hand study of the native economy, and an estimate of the status of the seals of Ungava Bay. Littoral collections were also taken, and Mr. Hildebrand made a representative collection of the birds of the region for the National Museum of Canada. Among the results immediately available were the finding of hydrographic conditions mid-way between the arctic conditions of the Baffin Island coasts and the marked sub-arctic waters of west Greenland; high biological production; and definite possibilities in certain areas of native fisheries for Atlantic cod, shark, and perhaps Greenland halibut. It is intended to continue and extend the work in 1948.

The Ungava Bay Fisheries Expedition of 1947, led by Dr. Dunbar, established a most interesting precedent in international research in the north, in that the party included a native Greenland fisherman, Josias Vetterlain of Jakobshavn. The purpose in bringing a Greenlander over to Ungava Bay was twofold; first to introduce into the minds of a few Ungava natives the idea of the possibility of marine fisheries (here was a man who says it works well among the Greenlanders), and secondly to have a man who would demonstrate the practical details of the fishing methods used in Greenland.

Josias was obtained through the willing cooperation of the Greenland Administration in Copenhagen, and the equally willing aid of the U.S. Army Air Force was enlisted in flying him to Fort Chimo, and home again in September. Josias joined the expedition at George River, and during the exploration of the eastern water of Ungava Bay he fulfilled all expectations in demonstrating the Greenland methods. The language of communication was, in the main, Danish. The Ungava Eskimos found considerable difficulty in understanding the north Greenland dialect, and at first the differences in pronunciation of a few words which were mutually understood caused great hilarity. Josias very soon accustomed himself to the new surroundings, and got along very well with the crew. The lessons he taught will be remembered by those who came in contact with him, and it is hoped that the experiment can be repeated in 1948.

ENTOMOLOGY

Studies of Arctic and Subarctic Colias Butterflies

Dr. William Hovanitz carried out reconnaissance field work at points ranging from central Alberta to the Arctic coast at Coppermine during the 1947 field season. The period of adult flight of Arctic *Colias*, is restricted to a period of about two weeks at any one locality. Observation of the local weather was

necessary in order to time the trip to coincide with the period of flight. Numerous species were observed and comparisons were made between the Alpine Zones of the Rockies and the true Arctic at sea level. Considerable additional work is required to understand the nature of hybridization between species of *Colias*. *Colias boothi* appears to be a product of hybridization between *C. hecla* and *C. nastes*, but whether it remains to be seen. The food plants, often the best diagnostic character for these species are unknown as yet.

MEDICINE

Queen's University Expedition to Southampton Island

The Queen's University Arctic Expedition which went to Southampton Island, North West Territories, in the summer of 1947 observed the morbidity of various diseases among the Eskimo, studied their nutritional habits and status, and carried out certain dietary experiments concerned with the tolerance of the Eskimo for pemmican, and the development of acidosis while on a high fat diet and during starvation. The party was made up of Dr. Malcolm Brown, Associate Professor of Medicine, Dr. R. G. Sinclair, Professor of Biochemistry, Dr. L. B. Cronk and Mr. George Clark, and was flown to its destination in planes of the Royal Canadian Air Force by way of Winnipeg and Churchill.

It was found possible to reach and examine medically eighty per cent. of the native population of Southampton Island. They were brought by boat to the clinic established by the Expedition at Coral Harbour where they were given a thorough medical examination and samples of blood and urine were collected. The results show that the chief causes of illness are respiratory tract infections and tuberculosis and these would also appear to be the chief causes of death. An interesting observation was the discovery that a third of those examined had livers which were considerably enlarged by ordinary standards. Specimens of liver obtained from two subjects showed that the enlargement was due to the presence of large amounts of fat, and further work is being done on this problem which is of considerable interest.

Evidence of serious nutritional deficiencies was widespread. Many of the children were underweight, some almost emaciated, and at all ages findings suggestive of riboflavin and ascorbic acid deficiencies were common. Determination of the blood ascorbic acid level confirmed the clinical conclusions with regard to ascorbic deficiency. Studies of excreta, which were carried out in association with Dr. E. E. Kuitunen of the University of Toronto, showed a high incidence of intestinal parasitic infection.

A small representative group of Eskimos was selected to determine average daily food intake, tolerance for pemmican, and the rate at which they develop acidosis during starvation. In contrast with Canadian and American soldiers the Eskimos could eat large amounts of pemmican without developing more than a mild acidosis. The acidosis became pronounced during starvation.

Much of the work of the party remains to be done. Large numbers of specimens of blood were brought back in a frozen condition and are now being analysed in the Department of Biochemistry. The results of these analyses will provide further information concerning fat metabolism of the Eskimo and his nutritional requirements.

PHYSIOLOGY

Scientific Research at Point Barrow, Alaska

At the instigation of the United States Office of Naval Research a scientific station has been set up at Point Barrow, headquarters of the No. 4 Naval Petroleum Reserve, a large area set apart over twenty years ago and now being actively explored and proved.

In the spring of 1947 a team of physiologists began preparations for a lengthy stay at the station. The party is led by Dr. Laurence Irving of Swarthmore College and includes Dr. Per F. Scholander, Dr. Reidar Wennesland, Dr. E. T. Nielsen, Mr. Walter Flagg, Mr. R. J. Hock, and Dr. D. R. Griffin.

The personnel reached Point Barrow by air early in August at the same time as the annual supply ships of the Navy arrived to discharge cargo for the whole base. In the cargo were the instruments and equipment for the research team including water baths, respirometers, and a large amount of equipment to keep laboratories at uniform temperatures, together with zoological field collecting kits.

The program of work is to measure oxygen consumption of animals in various temperatures to describe their metabolism in relation to Arctic conditions and to compare these metabolic rates with those of temperate and tropical animals. The heat economy of overwintering species will also be observed.

An early achievement was the collection of marine animals brought in by the storms from the Arctic Sea. Eskimo assistants are being used extensively for field observation and collecting and for constructing traps and cages for fishes, birds and mammals. Blue foxes and ground squirrels have been obtained in sufficient numbers for experimentation as have also snow bunting, marine isopods, and decapods and several species of fish and fresh water crustaceans.

Collections of plankton will be carried out through the winter and mice and lemmings, scarce at Point Barrow this year, have been obtained from Umiat in the interior. Twenty-five bears came in on the ice floes during September and were shot along twenty-five miles of coast, some by the research team thus causing enthusiasm for science among the natives.

Many field collecting trips have been made by air, land, and water including visits east along the coast to Barter Island and west as far as Wainwright. Journeys have been made up the Inaru, Meade, and Ikpikpuk rivers, and to Umiat and Chandler Lake inland, the latter at 3,000 feet in the Endicott mountains. The laboratory is one of the usual Quonset huts at the base, 20' by 40', heat being furnished by oil burning space heaters and circulated by small fans. Propane gas is used for burners and there is a supply of fresh and distilled water.

GEOLOGY

Geological Research Along the East Coast of Hudson Bay

Dr. E. H. Kranck of the University of Neuchatel spent the last week of July and all of August 1947 between James Bay and Port Harrison. The principal purpose of the field work was to observe the Precambrian bedrock of the coast, especially at Portland Promontory. In addition attention was given to topographic forms, post-Cambrian movements of the bedrock and to glacial and post-glacial geology. Dr. Kranck reports that the east coast of James Bay represents a typical

penepine surface cut into a Precambrian "rockground". The coast bears a striking resemblance to that of Finland. Along both coasts there is a "skerries guard" of barren rocky islands rounded by the inland ice, and an interior coastal zone with broad shallow bays filled with alluvium. From the sea the coast skyline is almost horizontal. Farther north, the coastline follows the contact between the Archaean rocks and the late Precambrian sediments and is generally very straight. The uplift which caused the seaward slip of the Nastapoka series must, in the opinion of Dr. Kranck be of comparatively recent age—possibly Tertiary.

Glacial drift along the east coast of the Bay is rather thin and is characterized by an abundance of drumlins. Glacio-fluvial deposits are abundant in all the big pre-glacial valleys. A well developed beach is found in the northern parts of the area at 300-309 feet.

Silliman's Fossil Mount, Baffin Island

During the month of August, 1947, A. K. Miller and Walter Youngquist travelled by air (and for a short distance by boat) to the head of Frobisher Bay in southeastern Baffin Island.

Camp was made near the mouth of the Jordan River at the base of Silliman's Fossil Mount. With the aid of an Eskimo, a considerable variety of well-preserved marine invertebrate fossils were collected. These included corals, bryozoans, brachiopods, pelecypods, gastropods, trilobites, ostracods, and particularly cephalopods. A detailed study of the collection is being prepared for publication. It confirms the Upper Ordovician age of the containing strata and indicates that they may be correlated with the Cape Calhoun beds of northern Greenland, the Red River formation of southern Manitoba, the Bighorn formation of Wyoming, and probably the Whitewater formation of Ohio and Indiana.

An hitherto unknown limestone outlier was discovered just west of the Jordan River and some 13 miles above its mouth. It is considerably larger than Silliman's Fossil Mount and is divided into two unequal parts by a tributary of the Jordan. The larger is several miles in length.

Geological Reconnaissance of Canadian Arctic Islands

Dr. Y. O. Fortier of the Geological Survey of Canada accompanied a party of the Dominion Observatory Magnetic Survey to Victoria, Prince of Wales, King William and Somerset Islands and to Boothia Peninsula during July and August 1947. On flights aggregating several thousands of miles he was able to observe bedrock geology, topographic forms, Pleistocene glaciation, present ice conditions and evidence of land emergence. Horizontal beds, apparently mainly of limestone were observed along the east coast of Victoria Island and a collection of fossils made at Greely Haven may establish the age of strata at what is now a blank area on the geological map. Contact zones between Precambrian and Palaeozoic rocks were observed near the west coast of Boothia Peninsula and at Fort Ross on Somerset Island.

The Arctic islands visited by Dr. Fortier display three types of topography; (1) low, poorly drained area displaying a multitude of lakes; (2) well-drained areas with many rivers, some of them deeply incised, and with few or no lakes. The land rises to perhaps 800 feet above sea level, some of the higher parts forming tablelands underlain by horizontal strata; and (3) rocky, rugged plateau

areas, especially well-dissected near the coast, with large tracts with few or no lakes and underlain by Precambrian rocks.

Boulder till, erratics, local striae and drumlinoids everywhere suggest that the Arctic islands visited were over-run by glaciers. Indications of the recent emergence of the islands from the sea are afforded by raised beaches and the presence of marine shells as much as 415 feet above sea level on the north coast of Prince of Wales Island.

Newfoundland-Dalhousie Labrador Expeditions 1946, 1947

Professor G. Vibert Douglas of the Department of Geology, Dalhousie University, Halifax, Nova Scotia, was leader of expeditions to Labrador in 1946 and 1947. The work was carried on under the auspices of the Newfoundland Commission of Government through C. K. Howse, Geologist. Personnel was recruited from Dalhousie University.

The 1946 field season opened with departure of the expeditions 50-ton auxiliary schooner from Halifax at the end of May. Purpose of the journey was to reconnoitre the whole coast of Labrador from Blanc Sablon on the Strait of Belle Isle to Cape Chidley. Calls were made at 31 points. At seven of them, detailed mapping was carried out, employing plane tables and transits. At the remaining twenty-four places less accurate methods of survey were employed. Results of the summer's work are reported in a bulletin of the Geological Survey of Newfoundland, now in the press.

The major topographical and geological features of the coast were determined, and five distinct mountain areas were shown to be present. From north to south they are: The Torngats, Kaumajets, Kiglapaits, Benedicts, and Mealys. The geological sequence for the coastal areas was determined, and the stratigraphical column of the Ramah Series was accurately measured. The pyritic deposits at Rowsell Harbour were mapped in detail. The report contains a section on the meteorology of the Coast by G. C. Milligan. Areas were selected for further detailed study, and some of this was complete during the following season.

During 1947, G. C. Milligan mapped instrumentally the area between Rowsell and Ramah. C. H. Smith mapped a strip about 15 miles wide from Tessijualik (incorrectly spelled Tuchialik on the 8-mile maps) to the south side of Kaipokok Bay. A further area was mapped along both sides of the Canairiktok river for a distance of 35 miles inland from the bay mouth.

Greenland Coal

Professor A. Rosenkrantz was leader of a geological field party to Svartenhoek Peninsula and Disko Island in northwest Greenland during 1947. The party which was one of several sent to the Colony by the Danish government, reported the discovery of new occurrences of coal and of natural gas. The newly found coal lies a few kilometres inland and would require transport to the coast before being shipped to settlements farther south.

SURVEYING

Geodetic Surveys in Northern Canada

During the 1947 season the Geodetic Service of Canada, Department of Mines and Resources, had six astronomic observing parties working in Mackenzie

District, N.W.T. These parties engaged in locating control points for aerial photographic mapping, worked in close co-operation with the Royal Canadian Air Force whose photo-survey squadrons provided two Canso amphibian and four Norseman aircraft to transport supplies, equipment and personnel.

Operations were carried on in the 105,000 square miles of Northern Canada located between the mouth of the Mackenzie River, Cambridge Bay and Great Bear Lake. Ice conditions in July, accidents to aircraft, and continuous bad weather in August prevented more than a quarter coverage of this area with twenty-two observation points. Lakes were not entirely free of ice until July 30th and freezing temperatures with snow storms hampered flying from August 15th to the end of the month when field operations terminated. Eighteen astronomic control points were also established in the James Bay and southern Hudson Bay area. Eight of these points were fixed by a canoe party which left Moosonee on May 28, but, owing to the late break-up did not reach Albany until June 17. Akimiski Island was circumnavigated on the way north, and York Factory reached on August 29. The party was flown out from there by R.C.A.F. Canso. A second party established points at Rupert's House, Charlton, Weston, North Twin, Walter, Grey Goose, Bare and Bear islands, and two points inland west of Moosonee. They worked from a chartered Roman Catholic mission boat until it was wrecked on Grey Goose Island. Transportation for the remainder of the summer was provided by Austen Airways. The control stations were photographed by R.C.A.F. planes flying from Churchill, Kapuskasing and Ottawa. Both parties made observations on the fauna and ecology. Seven hundred and fifty birds were collected for the National Museum.

FROZEN GROUND

Permafrost at Norman Wells, N.W.T.

A permafrost investigation by R. A. Hemstock is being carried on at Norman Wells in conjunction with general construction program of the Imperial Oil Company. It has been found that temperatures are the most important single factor in the formulation of adequate designs for the permafrost region. Complete air temperature records have been kept over the past four years, and other temperature readings were begun in 1947. Among these other records are air temperatures taken under the plant boiler house. The effect of a temperature rise beneath the floor on frost level will be determined.

During the 1947 summer the construction program required the driving of 780 piles. As these piles were driven, thermometer wells were located along the full length of several piles. Temperature records are being kept to show the rate of back-freezing, and the final temperatures reached along the length of the pile. Although all piles used are steel, some wooden piles were driven to give comparisons in the above work. The results indicate that metal piles freeze in very quickly—and may therefore be loaded almost immediately after driving.

At present tests are being carried out at several of the abandoned oil wells in the vicinity to determine the depth of permafrost. This will include tests near the Mackenzie River and also at some distance from it. Results, so far, indicate permafrost to a depth of 140' at Norman Wells. Temperatures have also been taken at intervals over this depth.

NEWS FROM HIGH LATITUDES

Letters from Eureka Sound, 80°N. Latitude

Dr. A. L. Washburn, Executive Director of the Arctic Institute, has a correspondent at the new Canadian-United States weather station at Slide Fjord, Eureka Sound, in latitude 80°N. Writing in August, before the arrival of the supply vessel *Edisto*, Mr. Murray C. Dean noted that the climate was far more temperate than had been anticipated. He went on the "The fjord ice in April, the month we arrived here, measured 82 inches. A shore to shore crack developed in the last few days of May, and grew wider day by day. At about the same time our brook began to run and water started to form on the shore ice. Today (August 3rd) the fjord is about 60 per cent pan ice. Musk oxen abound; we see them daily in the valleys around us. Before our two dogs passed away we found that we could get reasonably close to a herd of four or five to take photographs, as the dogs would keep them in a defensive square. Though a rarity these days, in the spring we were often besieged by packs of wolves, singly, in pairs and in packs of up to sixteen".

Mr. Dean then reported an incident that puzzled members of the weather station staff—the discovery of a kerosene can marked "40" and "DDPA". This relic, at a place rarely visited, was presumably left by the Danish Van Hauen Expedition which visited the area by sledge from Greenland in April, 1940.

Mr. Murray Dean in a letter written from Eureka Sound on December 4th, 1947, reports a low temperature of -47°F. up to that time, with a mean of -20.1°F. for November. The first frost was on August 27th. The musk oxen seemed to have deserted the area. The letter ends "for the last two days we have been besieged by wolves which have ventured time and again to the doorsteps and have killed one of our dogs. We are forever running outdoors with firearms".

Danish Three Year Expedition to Northeast Greenland

Ebbe Munck and Eigil Knuth began in 1947 reconnaissance for a two year expedition to northeastern Greenland. The open season was employed in locating bases to be occupied from 1948-50. Two vessels, SS *Godthaab* and MV *Gamma* together with a Catalina aeroplane *Mameluk* carried personnel and stores. A suitable permanent base for the 1948 party of ten men was located on the northern side of Independence Fjord in 82°30' N. Lat.

Eigil Knuth returned to Copenhagen with nine others from Zackenberg, northeast Greenland on September 1st, 1947, in a twelve hour flight. He reported that bad weather prevented the reconnaissance group from making more than five flights of the fifteen planned, but they found Brönlundfjord clear of ice at the end of July, and located a hitherto unknown lake about 100 km long, also free from ice. Ebbe Munck returned to Denmark on September 11th with the remainder of the expedition personnel on SS *Godthaab*. He reported that work in 1948 will be started by air before ice conditions permit vessels to reach the northeast Greenland coast. Research will include mapping, geology, botany and glaciology of the interior of Pearyland as well as the coast. A meteorological and radio station will be established.

1947 Cruise of R.C.M.P. Schooner St. Roch

Floating R.C.M.P. detachment *St. Roch* sailed from Vancouver, B.C., June 30, 1947, for Winter Harbour on the south shore of Melville Island, N.W.T.

After calling at Dutch Harbour, Alaska, on July 12, the vessel continued to Herschel Island reaching there on July 27. At Walker Bay on August 12, Inspector H. A. Larsen, Master of the vessel, realized that ice conditions would make the voyage unusually difficult as ice from Melville Sound was being forced into Prince of Wales Strait. On September 1, *St. Roch* was off Peel Point, north-west Victoria Island when McClure Strait was jammed with ice. At this time U.S.S. *Edisto* was endeavouring to reach Winter Harbour from the east. Rather than delay for a possible crossing of Melville Sound, Inspector Larsen was ordered to return to Herschel Island for wintering. On arriving there five of the crew were picked up by R.C.M.P. aeroplane and flown outside to Edmonton. Inspector Larsen later travelled to Aklavik by dogteam and flew "outside" in December.

Northern Weather Stations

The meteorological network in northern Canada is being extended by the erection of new stations on Arctic islands. The first was established at Slidre Fjord on western Ellesmere Island in April, 1947. Men and equipment were flown in and landed on the sea ice from the joint Danish-United States station at Thule, Greenland. The second station was established by sea at Resolute Bay on Cornwallis Island. These and two subsidiary stations to be built by air in April, 1948, on the northwestern fringe of the Arctic islands are under joint Canadian-United States operation.

Three United States Navy ships left Boston in mid-July 1947, to carry men, equipment and supplies to the station at Slidre Fjord and to a proposed site at Winter Harbour. U.S.S. *Edisto*, a 6,900 ton icebreaker of the "Wind" type, was able to reach Eureka Sound through Jones Sound and Norwegian Bay, but failed in four attempts to reach Winter Harbour during August and received some damage in the attempts. An experimental automatic weather station was placed a short distance from the R.C.M.P. post at Dundas Harbour on Devon Island.

French Scientific Expedition to Greenland 1948-1950

Paul E. Victor, who is well known in North America for his Arctic service during the recent war, is to be the organizer and leader of a French expedition to northern Greenland. The expedition, which will leave France shortly, plans to make several crossings of the Icecap during two seasons of about five months each using "Weasels". A meteorological station, equipped to make radiosonde observations will operate for several years at about 75°N. Lat. and 40°W. Long.

The Academie des Sciences of the Institute de France is sponsoring scientific work which is being co-ordinated with the program of the International Glaciological and Meteorological Year. Cost of the expedition is being borne in part by the Centre National de la Recherche Scientifique and in part privately. The expedition has been authorized by the Danish Greenland Administration.

New Arctic Ship for Canada

At the time of the loss of the Hudson's Bay Company vessel R.M.S. *Nascopie* in 1947, plans were already far advanced to construct a government-owned vessel for supplying Eastern Arctic settlements. The new ship is to be 276 feet long, of about 2,615 tons deadweight with capacity for 1,000 tons of cargo. Passenger accommodation is to be 88, in addition to a crew of 58 persons. Powered by 4,000 H.P. steam engines the new vessel will be capable of 14 knots.

The hull will be reinforced for protection against ice. The ship will carry a helicopter for scouting ice conditions. Northern voyages are likely to take three to four months each year, at other times the vessel will be available for ice-breaking on the St. Lawrence and for routine supply voyages along the eastern coast of Canada. The new ship is being constructed at Levis, Que.

Oil in Northern Alaska

Drilling is going on in the United States Navy Petroleum Reservation No. 4, in the Point Barrow region of Alaska. The object is to discover whether there is sufficient oil in the area to justify commercial exploitation. Preliminary exploration was carried on in the area twenty-five years ago, but serious work began in 1944. Drilling is being carried out by a syndicate of Texas companies under the name of "Arctic Contractors". Supplies arrive at Barrow by ship and are unloaded into scows, at other times of the year they are carried overland by air. Among outstanding feats is the freighting of drill pipe and other heavy equipment from Fairbanks to the Arctic coast by D.C.4's. "Weasels" have been found extremely useful during the summer season. Trains of sleds hauled by large tractors convey equipment and personnel to the interior from the coast during the winter. The key administrative and supply centre is at Umiat inland from Point Barrow. Exploratory work is scheduled to be completed before 1950.

Norwegian Expedition to the Antarctic 1947-48

The Norwegian Geographical Society was responsible for planning and equipping a small scientific expedition which left for the Antarctic late in 1947. The main purpose of the expedition, which is being financed by the Norwegian Whaling Association, is to carry on routine study of Antarctic waters in an area not regularly visited by whalers.

A 500 ton steel fishing vessel *Bratteg* is being used to carry four scientists and a crew of seventeen. Scientific staff includes a specialist in Antarctic birds, two physical oceanographers, and a marine biologist. If ice conditions are favourable a landing may be made on Peter Island.

Australian National Research Expedition

Australia has resumed exploration and research in the Antarctic on a considerable scale. The government expedition of 1947 has established stations on Heard Island and Macquarie Island using L.S.T. 3501 for transport. *Wyatt Earp* is making an extensive cruise, which if successful will result in a permanent station being established on the Antarctic continent. Daily weather observations are being transmitted to Australia from the two land stations. Other scientific work includes the study of cosmic rays using both a geiger counter and an ionisation chamber, magnetic readings, aurora investigations, measurement of the ozone content of the air, and of the reflection of radio waves from the ionosphere. Other work includes the collection of plankton water samples, taking soundings, and studies of whales, sea elephants and fish. Geologists will map Heard Island. The magnetic station at Sir Douglas Mawson's old base on Commonwealth Bay, not far from the magnetic pole may be reoccupied.

On the Antarctic continent itself elaborate studies of glaciers are planned together with seismic ice thickness determinations and geophysical prospecting.

All stations are to be under the direction of Group Captain S. A. C. Campbell with Mr. P. G. Law as senior scientific officer.

